



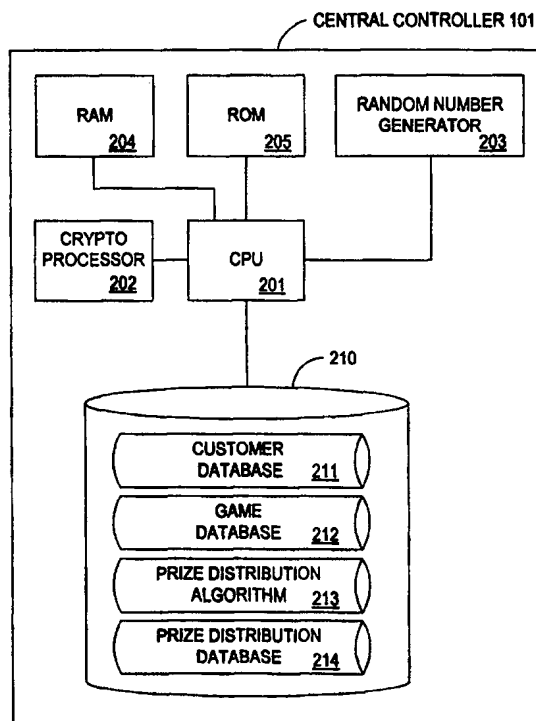
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : <b>A63F</b>		<b>A2</b>	(11) International Publication Number: <b>WO 99/01188</b>
			(43) International Publication Date: 14 January 1999 (14.01.99)
(21) International Application Number: PCT/US98/13909 (22) International Filing Date: 2 July 1998 (02.07.98) (30) Priority Data: 08/888,049                      3 July 1997 (03.07.97)                      US (71) Applicant: WALKER ASSET MANAGEMENT LIMITED PARTNERSHIP [US/US]; 5 High Ridge Park, Stamford, CT 06905-1325 (US). (72) Inventors: WALKER, Jay, S.; 124 Spectacle Lane, Ridgefield, CT 06877 (US). SCHNEIER, Bruce; 101 East Minnehaha Parkway, Minneapolis, MN 55419 (US). JORASCH, James, A.; Apartment 5G, 25 Forest Street, Stamford, CT 06901 (US). VAN LUCHENE, Andrew, S.; 13-2A Clarmore Drive, Norwalk, CT 06850 (US). (74) Agent: ANDERSON, Jay, H.; Fitzpatrick, Cella, Harper & Scinto, 30 Rockefeller Plaza, New York, NY 10112-3801 (US).		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>Without international search report and to be republished          upon receipt of that report.</i>	

(54) Title: METHOD AND APPARATUS FOR SECURING ON-LINE VIRTUAL PUNCHBOARD TRANSACTIONS

## (57) Abstract

A system is described for facilitating an Internet-based game of chance, particularly a computer-based version of a punchboard game having a grid with prizes associated with the various grid locations. The user can pay a central controller for each selection by providing a credit card number, or through other Internet transaction means. The central controller sends the user a fresh virtual punchboard (i.e. a game in which no selections have yet been made). The user selects a grid location, encrypts it, and then transmits it to the central controller. The central controller then generates prize values for the grid that it sent to the player. The user's computer stores the locations of each prize and determines whether the player's selection was a winner. If he has won, the player sends the decryption key to the central controller to decrypt his grid selection and authenticate his selection. The central controller then initiates a payment to the user.



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## TITLE

METHOD AND APPARATUS FOR SECURING  
ON-LINE VIRTUAL PUNCHBOARD TRANSACTIONS

## BACKGROUND OF THE INVENTION

This invention relates to an electronic gambling game in which a player selects from a series of possible outcomes. The player and game provider may interact in  
5 a variety of ways, including over the Internet.

A number of well-known gambling games are based on a player selecting from a series of possible outcomes, where the winning outcome is randomly generated using  
10 some physical or mechanical device furnished by the game operator. Examples of such games are roulette, slot machines, and bingo. In the classical embodiments of these games, the player sees and/or hears the outcome generated (as in bingo and roulette), or even  
15 has a hand in generating the outcome himself (as in slot machines). The player's trust in the fairness of these games (that is, his belief that the outcome is random and that his selection, if a winner, will be honored) is largely based on his personal observation.  
20 Similarly, the game operator can use various methods to prevent cheating by a player if the player is

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personally present; for example, a bingo player claiming to be a winner is required to offer his card for inspection.

- 5 A well-known example of an entertainment/gambling device is the "punchboard." A punchboard consists of a board with a square grid of holes. Each hole contains a small rolled-up piece of paper. The player takes a pin and pushes through the board, pushing a selected  
10 piece of paper through the other side. This paper is then unrolled by the player to reveal whether or not he has won a prize. In a typical punchboard game, a player pays a small sum (approximately \$1) to make a selection; prizes are determined by the size of the  
15 board and the fees, and may run hundreds of dollars.

Here, too, the player's confidence in the fairness of the game is largely based on his observation of the board; since he selects a piece of paper and can  
20 immediately read the message on it, he can be sure that the paper is not switched or tampered with after he selects it. In addition, by watching a number of plays he can eventually satisfy himself that there are indeed winning locations somewhere on the board. A successful  
25 electronic version of a punchboard game (a "virtual punchboard") must offer the player similar assurance that the game is not rigged, and must also prevent cheating the player.

- 30 Various forms of electronic games of chance have been available for many years. The way these games are played, however, is changing dramatically with the use of digital computers operating on electronic networks such as the Internet. Players can now connect to a  
35 remote server and wager electronically. Rather than traveling to the game (casino, bingo hall, etc.), a player can log into an electronic game and wager from

the comfort of his own home. While this remote playing has many advantages, it raises several security issues. In a typical electronic gambling game, the player enters his selection and then learns whether he has  
5 won, without observing the winning selection being generated. For example, when playing card games at a casino, a player can observe the dealer shuffle and deal the cards and thus has some confidence that the outcome was generated randomly. In an electronic  
10 casino, the shuffling process is typically digitally generated, driven by random number generators which the player cannot see. The player cannot know whether the random number generated is truly random or was selected by the casino to give it an advantage.

15 Furthermore, a player desiring to play an electronic game remotely (for example, communicating with a game provider on the Internet) must send his selection and receive the winning selection over a communication  
20 network. In this instance, both the player and game provider require assurance that the communications are secure and that the game is conducted fairly.

Electronic game providers have tried to increase  
25 players' confidence in the legitimacy of games by assuring players that gaming software has not been tampered with. For example, an electronic game provider may allow an independent third party to perform an audit of the software. This is a time-  
30 consuming and expensive process, however. With complex software running into the hundreds of thousands of lines of code, it is very difficult to find a few lines of code that alter the randomness of the outcomes. Also, use of an independent, third party auditor shifts  
35 the need for trust to another party, and does not guarantee the legitimacy of the game.

Some electronic lottery systems have used methods for securing communications between remote player terminals and a central controller. For example, U.S. Patent No. 4,652,998 to Koza et al. ("Video Gaming System With  
5 Pool Prize Structures") describes cryptographic methods for securing these communications. In games dependent on the use of random numbers, however, simply securing against the transmission of a fraudulent random number does not solve the problem of assuring the player that  
10 the game is fairly conducted. Nor does it solve the problem of preventing multiple players from cooperating to gain an advantage over the game provider.

U.S. Patent No. 5,326,104 to Pease et al. ("Secure  
15 Automated Electronic Casino Gaming System") describes a system whereby a number of keno playing devices, all within the same playing area, are connected to a central controller. A player can play a device by inserting a player account card into it which is  
20 registered and confirmed by the central controller. Security in this system is directed primarily to ensuring that players will not tamper with the keno terminals, and that employees will not enter false tickets into the system. Apparently it is assumed that  
25 the central controller is trusted and will not try to cheat the players.

U.S. Patent No. 5,569,082 to Kayer ("Personal Computer Lottery Game") describes a game whereby a player can  
30 purchase a game piece containing an encrypted code which determines whether the piece is a winning one. The player logs onto a central site, via a PC or a kiosk, and types in the code. The site runs a game which reveals to the player if he is a winner in "an  
35 exciting fashion." If the player is a winner, he will be given instructions by the site as to where to pick up his prize. Although the system described in this

patent provides encryption to protect the site from fraud, it offers no encryption to protect the player.

U.S. Patent No. 5,547,202 to Tsumura ("Computer Game  
5 Device") describes a system whereby a player can pay  
for the usage of games transmitted to his PC or to a  
kiosk via satellite from a central controller. The  
games are scrambled until payment is made. The central  
controller can store a game so that a player can take  
10 breaks from a game, return to it and continue play from  
the point in the game at which he left it. This system  
has neither a gambling element nor is it  
cryptographically enabled.

15 U.S. Patent No. 5,269,521 to Rossides ("Expected Value  
Payment Method and System For Reducing the Expected Per  
Unit Costs of Paying and/or Receiving a Given Amount of  
Commodity") describes a system where a customer  
exchanges encoded numbers with a product vendor. After  
20 being decoded, the two numbers are combined to  
determine a result. (See column 30, lines 1 to 5, as  
well as column 30, line 35, to column 31, line 55).  
The transactions described are not conducted in an  
online manner. Additionally, both parties must encode  
25 their numbers before exchanging them. No game results  
are ever exchanged in encoded form.

U.S. Patent No. 4,309,569 to Merkle ("Method of  
providing digital signatures") describes a system for  
30 digital signatures utilizing hash trees.

The proliferation of electronic network technology,  
along with the ease of user access to networks such as  
the Internet, has dramatically increased electronic  
35 communications and the exchange of information. Among  
a myriad of other uses, these networks facilitate the  
playing of games, including gambling activities. They

are particularly well suited for such gaming because of their ability to collapse geographic distances while linking distributed players. As discussed above, however, the electronic implementation of games, and particularly gambling activities, often results in the loss of confidence and validity otherwise imbued in players from their personal observation of traditional gaming procedures (for example, dealing cards, spinning roulette wheels, etc.).

10

There thus exists a need in the art for systems and procedures which can both actually and in the perception of players improve the security and operation of electronic gambling and games. Such systems and procedures would not only foster the perception of on-line gaming as legitimate, but also increase player participation in such activities. This would further increase the commercial value of what is already a substantial online business.

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#### SUMMARY OF THE INVENTION

25 In accordance with the present invention there is provided a new and improved method and apparatus for facilitating computer-based games of chance on electronic networks such as the Internet. A key feature of the invention comprises the use of encoding techniques, including various encryption schemes, to validate the operation of the games and prevent cheating by either the player or the game provider. Although encryption methods are described, it should be noted that any encoding scheme which prevents the recipient of a message from deciphering its contents will suffice.

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In accordance with one embodiment of the invention, a method of generating and verifying the results of a computer-based game of chance is implemented by transmitting to a player computer a plurality of  
5 available game selections, each identified by a unique selection identifier. A player selection identifier is received from the player computer, and a winning selection identifier transmitted to the player  
10 computer. The player selection identifier and the winning selection identifier are compared to determine if the player has won the game. In accordance with the invention, verification is made that the winning selection identifier and the player selection identifier were independently generated.

15 Game operation is preferably managed by a central controller, with players communicating with the controller through player computers connected over an electronic network. In different embodiments of the  
20 invention, verification of authenticity is provided in the central controller, the player computer, some combination of both, or with the involvement of a third party.

25 Games supported include all games of chance which permit a user to select from amongst a plurality of potentially winning selections. Applicable games include, but are not limited to a punchboard having punch locations, a roulette wheel having wheel numbers,  
30 a bingo game having user-selected card numbers, and a slot machine having user-selectable outcomes.

Verification is provided through a variety of techniques, including the use of encryption such as  
35 key-based encryption, and hash-based encryption. The invention further contemplates the use of a third-party

trusted agent to monitor and verify that the player and winning selections were independently generated.

5 BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a block diagram showing an overview of the system of the present invention.

10 Figure 2 is a block diagram of the central controller of Figure 1.

Figure 3 is a block diagram of the user computer of Figure 1.

15

Figure 4 is a block diagram of a trusted third party computer.

20 Figure 5 is a schematic representation of the punchboard game area before a game has been played.

Figure 6 is a schematic representation of the punchboard game area after a game has been played.

25 Figure 7A shows in tabular form the fields of the customer database of the central controller.

Figure 7B shows in tabular form the information in the prize distribution database of the central controller.

30

Figure 8 is a flowchart describing initiation of a game according to the preferred embodiments of the present invention.

35 Figure 9A shows in tabular form the information in the audit database of the user computer according to the first embodiment of the invention.

Figure 9B shows in tabular form the information in the game database of the central controller according to the first embodiment of the invention.

5 Figures 10A and 10B are connected flowcharts describing the flow of play between the central controller and user computer according to the first embodiment of the invention.

10 Figure 11A shows in tabular form the information in the audit database of the user computer according to the second embodiment of the invention.

Figure 11B shows in tabular form the information in the  
15 game database of the central controller according to the second embodiment of the invention.

Figures 12A and 12B are connected flowcharts describing the flow of play between the user computer and the  
20 central controller according to the second embodiment of the invention.

Figure 13A shows in tabular form the information in the audit database of the user computer according to the  
25 third embodiment of the invention.

Figure 13B shows in tabular form the information in the game database of the central controller according to the third embodiment of the invention.

30 Figures 14A, 14B and 14C are connected flowcharts describing the flow of play between the user computer and the central controller according to the third embodiment of the invention.

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Figure 15A shows in tabular form the information in the audit database of the user computer according to the fourth embodiment of the invention.

- 5 Figure 15B shows in tabular form the information in the game database of the central controller according to the fourth embodiment of the invention.

Figure 16 is a flowchart describing the flow of play  
10 between the user computer and the central controller according to the fourth embodiment of the invention.

Figure 17A shows in tabular form the information in the audit database of the third party according to the  
15 fifth embodiment of the invention.

Figure 17B shows in tabular form the information in the game database of the central controller according to the fifth embodiment of the invention.

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Figures 18A and 18B are connected flowcharts describing the flow of play between the user computer, the central controller, and the third party computer according to the fifth embodiment of the invention.

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#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An overview of the system in the preferred embodiments  
30 of the present invention is shown in Figure 1. The central controller 101, operated by the game provider, communicates with the user computer 102 (operated by the game player) over the Internet 100. Figure 2 is a schematic diagram of the structure of the central  
35 controller 101. The central controller includes a CPU 201, connected to a cryptoprocessor 202, a random number generator 203, RAM 204, ROM 205 and a data

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storage device 210. The CPU 201 connects to the Internet for communication with the player's computer. The data storage device 210 includes a customer database 211, a game database 212, storage for the prize distribution algorithm 213 and a prize distribution database 214. To perform the various functions described in more detail below, the CPU 201 executes a program or programs stored in RAM 204 and/or ROM 205.

10

Cryptographic processor 202 supports the encoding and decoding of communications with players, as well as the authentication of players. An MC68HC16 microcontroller, commonly manufactured by Motorola Inc., may be used for cryptographic processor 202. This microcontroller utilizes a 16-bit multiply-and-accumulate instruction in the 16 MHz configuration and requires less than one second to perform a 512-bit private key operation. Other exemplary commercially available specialized cryptographic processors include VLSI Technology's 33MHz 6868 or Semaphore Communications' 40 MHz Roadrunner 284. Alternatively, cryptographic processor 202 may be configured as part of CPU 201.

25

A conventional random number generating processor may be used for random number generator 203. The HEMT integrated circuit manufactured by Fujitsu, for example, is capable of generating over one billion random numbers per second. Alternatively, random number generator 203 may be incorporated into CPU 201. Data storage device 210 may include hard disk, magnetic, or optical storage units, as well as CD-ROM drives or flash memory.

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The user computer 102 is shown schematically in Figure 3. The user computer includes a CPU 301, connected to

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a cryptoprocessor 302, a random number generator 303, RAM 304, ROM 305 and a data storage device 310. The CPU 301 is also connected to an input device 320 and to the Internet, for communication with the user and the central controller respectively. In addition, the CPU 301 is connected to a display device 330 for displaying a virtual punchboard to the user. The data storage device 310 includes an audit database 311. The CPU 301, cryptoprocessor 302, random number generator 303 and data storage device 310 may have the same features as CPU 201, cryptoprocessor 202, random number generator 203 and data storage device 210 discussed just above.

Figure 4 is a schematic diagram of a trusted third party computer 400, which is used in an embodiment of the invention discussed in more detail below. This computer includes a CPU 401, RAM 404, ROM 405 and data storage device 410, similar to central controller 101 and user computer 102. The data storage device includes an audit database 411. The CPU 401 is connected for communication with the user computer 102 and the central controller 101.

Figure 5 shows the appearance of a virtual punchboard display 500, displayed to a user on the display device 330, before a game is played. The game is identified by a number 510, and an empty grid 511 is shown (in this case, a 12 x 12 square). A box 512 appears where the player may enter his selected grid locations. The player's current credits 513 (how much he has paid for the present game, plus his winnings so far) may also be displayed; in the example shown, the player has no winning balance and has just made an electronic payment of \$1 to play game # 6465484564.

Figure 6 shows a results display 600, similarly displayed to the user by display device 330, after the game is played. The winning locations are displayed in a table 610 and on the grid 611, with the player's selection circled on the grid and displayed in a box 612. Also displayed is the result of the game (in this case the player is told, "YOU WIN!") and the balance 613 of the player's winnings. Finally, the display includes a box 620 labeled "PLAY AGAIN?" The CPU 301 may advantageously execute interactive display software (stored in RAM 304 or ROM 305) which enables "click boxes" and the like. In that case, the player would click on the "PLAY AGAIN?" box to order a new game.

Figure 7A shows the fields of the customer database 211 maintained by the central controller 101. Each customer is identified by name 701 and is assigned an ID number 702. Each customer entry in the database also includes a credit card number 703, the customer's e-mail address 704 and postal mailing address 705, the total amount the customer has spent 706, and the customer's total winnings to that point 707. The database stores the grid selection preferences 708 for each customer (so that a player who regularly plays the same location on the grid need not enter that location in every game), and the customer's preferred method 709 of receiving his winnings.

The fields of the prize distribution database 214, maintained by the central controller 101, are shown in Figure 7B. Each prize distribution is assigned an identification number 711. Each entry in the database includes the size 712 of the grid, the denomination of the game 713 (that is, the cost to the customer for one play) and the number and amount of prizes 714 to be awarded. Generally, a larger grid has more prizes

associated therewith, and a grid with larger prizes has a larger associated denomination.

To create a new game, the central controller 101  
5 employs a prize distribution algorithm 213 having the following steps: The central controller 101 retrieves the prize structure 714 and grid size 712 from the prize distribution database 214 by searching for the prize distribution ID number 711. The CPU 201  
10 instructs the random number generator 203 to produce enough random numbers to cover the number of grid locations for the game. Each random number is appended to a grid location. The format might be (x,y,r), where "x" is the x-coordinate of the grid location, "y" is  
15 the y-coordinate of the grid location, and "r" is the assigned random number. The random numbers are then ranked numerically. Prizes are then appended to each grid location. The format might be (x,y,r,p), with "p" the prize value (which may be zero) assigned to the  
20 grid location (x,y). The game is then assigned an ID number. The winning grid locations for the game, and the prizes associated with those locations, are then stored in the game database 212, detailed embodiments of which are described below. Those skilled in the art  
25 will appreciate that there are many possible algorithms by which the prizes may be randomly assigned. The above algorithm is merely illustrative

#### First Embodiment (User Computer Encryption)

30 In the first embodiment of the invention, the fields of the audit database 311 (stored in the user computer 102) are as shown in Figure 9A. Each record in the audit database 311 corresponds to one game played by  
35 the user, and is filled in as the game progresses (as described in detail below). A record includes an identification number 901 for the game, the grid



location or locations 902 selected by the player, the winning grid locations 903, the game denomination 713, and a random key 904 which the player uses to encrypt his grid location selections.

5

In this embodiment, the fields of the game database 212 (stored in the central controller 101) are as shown in Figure 9B. Each record in the game database corresponds to one game (having an ID number 901) played by one player (having an ID number 702). Each record includes the winning grid locations 903, the player's selected and encrypted grid location 910, the corresponding decrypted grid location 920, and the player key 904.

15

A game conducted according to the first embodiment of the invention begins with the steps shown in the flowchart of Figure 8. Initially, the player (using his computer 102) logs on to the central controller 101 via the Internet 100 (step 801). If the player does not yet have an account (that is, an entry in the customer database 211), an account is opened at this time; the player provides the necessary information (step 804), and the central controller 101 assigns him an ID number and stores the new record in the customer database 211 (step 805). If the player already has an account, he enters his customer ID number 702 (step 810).

The player then selects the amount of money he wishes to play--that is, the denomination of the game; for example, \$1, \$3, or \$5 (step 820). The user computer 102 updates the denomination field 713 in the audit database 311 (step 830). The central controller 101 debits the credit card account of the player for the amount of money played (step 840). The central controller 101 retrieves a new game grid from the prize distribution database 214 (step 850). Using the prize

distribution algorithm 213 described above, the central controller 101 generates the winning grid locations 903, assigns the game identification number 901 and stores the game in the game database 212 (step 860).

5

In this embodiment, the game continues with the steps shown in the flowcharts of Figures 10A and 10B. In step 1001 of Figure 10A, a "blank" punchboard 500 including the game identification number 510 is made  
10 available to the player. The player selects a grid location 902 and enters it into the user computer 102 using input device 320 (step 1002). The cryptographic processor 302 of the user computer 102 generates a player key 904, preferably based on a random number  
15 generated by random number generator 303 (step 1003). The cryptographic processor 302 encrypts the grid location selection 902 with the player key (step 1004). The user computer 102 stores the game identification number, player key, and grid location selection in the  
20 audit database 311 (step 1005).

In step 1006, the encrypted grid location and game identification number are transmitted to the central controller 101. The central controller then retrieves  
25 the record in the game database 212 corresponding to the game identification number received from the user computer 102 (step 1007). The central controller 101 stores the encrypted grid location 910 in the game database 212 (step 1008).

30

At this point, the central controller 101 has the player's grid location selection, but only in an encrypted form. The central controller 101 then transmits the winning grid locations 903 to the user  
35 computer 102 (step 1010 of Figure 10B).

If the player has not won, he may proceed to select a new game (step 1061). If the player has won, the user computer 102 transmits the player key 904 and game identification number to the central controller 101 (step 1051). The central controller decrypts the encrypted grid location 910, and stores the decryption result 920 (the player's selected, winning grid location) and player key 904 in the game database 212 (step 1052).

10

The amount of money won by the player is retrieved from winning grid location field 903 of the game database 212 (step 1053). The central controller 101 then sends the game result message 600 to the user computer 102, indicating that the player has won (step 1054). The central controller then proceeds to generate the next game (step 1055).

At the end of the billing cycle, the central controller 101 queries the customer database 211 to see if the customer is owed money (step 1056). If money is due the customer, the central controller 101 initiates a payment to the customer according to the customer's preferred payment method 709 (step 1057).

25

It should be noted that a key element of this embodiment is that the user sends his grid location selection in encrypted form (thus unreadable by the central controller 101) to the central controller before receiving the winning grid locations. The player is thereby assured that the game provider cannot change the winning locations based upon knowledge of his selection. On the other hand, the central controller holds the player's encrypted selection before the player is given the winning locations, and the player must provide the key to decrypt his selection before the central controller awards him a

35

prize. The encryption of the player's selection thus assures both parties that the game has been fairly conducted, and that the two numbers were independently generated.

5

A transmission between the central controller and the player may include a digital signature to provide further assurance of the authenticity of the transmission, and to prevent repudiation by the sender.

10 The uses and advantages of digital signatures are discussed generally in Schneier, "Applied Cryptography" (2d ed. 1996), chapter 2.

The above embodiment is also applicable to a game such  
15 as roulette. Instead of encoding his grid location selection, the player encrypts his number selection (representing any of the 38 wheel slots). The central controller then transmits the result of the wheel spin to the player.

20

The game of bingo could be simulated as follows. The player selects a board and then encrypts his selection before sending it to the central controller. The central controller then sends out each bingo number  
25 until one of the players claims a win. The winning player sends his key to the central controller so that his selection can be verified.

To simulate a slot machine, the player simply selects  
30 one of the possible reel combinations of the slot machine. In a slot machine with three reels and 20 stops per reel, there are 8,000 (20 X 20 X 20) possible outcomes, so the player could select one of these at random, encrypting the selection and sending it to the  
35 central controller. The central controller then distributes the prizes among the possible outcomes and

sends the complete set of outcomes to the player so that he can determine whether or not he has won.

Second Embodiment (One-Way Hash)

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In the second embodiment of the invention, the audit database 311 in the user computer 102 has a structure as shown in Figure 11A. As in the first embodiment, each record in the audit database corresponds to one  
10 game. A record includes the game identification number 901, selected grid location or locations 902, winning grid locations 903 and the game denomination 713, similar to the record shown in Figure 9A. In this embodiment, the record also includes the hash value  
15 1101 of the winning grid locations 903.

The structure of the game database 212 in this embodiment is shown in Figure 11B. Each entry in the game database has a game identification number 901, a  
20 customer identification number 702 and the winning grid locations 903, as in the first embodiment. The entry also has the user-selected grid location 902 and the hash value 1101 of the winning grid locations 903.

25 A game conducted according to the second embodiment of the invention begins with the steps shown in the flowchart of Figure 8 as already described above, and continues with the steps shown in the flowcharts of Figures 12A and 12B. In step 1201 of Figure 12A, the  
30 cryptoprocessor 202 of the central controller 101 retrieves the winning grid locations 903 of the game from the game database 212, and uses a one-way hash function to hash the winning grid locations 903, thereby generating the hash value 1101. The hash value  
35 1101 represents a one-way transformation of the winning grid locations 903.

An important feature of the one-way hash function is that it is computationally simple (given the hash function) to generate the hash value, but computationally unfeasible to recreate the winning grid locations from the hash value alone. The hash value 1101 thus serves as a unique identifier for the winning grid locations 903, without the winning grid locations themselves being revealed. Further details on one-way hash functions are given in Schneier, "Applied Cryptography" (2d ed. 1996), chapter 18.

The central controller 101 distributes the hash value 1101 to the user computer 102, along with a "blank" punchboard 500 with game identification number 510 (step 1202). The user computer 102 stores the hash value and game ID number in the audit database 311 (step 1203). In step 1204, the player selects a grid location and enters it into the user computer 102; the player may make additional grid location selections. Once the player has made all of his selections, the user computer 102 stores the game identification number 901, the selected grid locations 902 and the hash value 1101 in the audit database 311 (step 1211). The user computer 102 transmits the selected grid locations 902 to the central controller 101 along with the game ID number (step 1212). It should be noted that at this point the central controller 101 has the player's selections, but has already provided the player with a representation of the winning grid locations in the form of the hash value 1101. In step 1213, the central controller 101 determines whether the player has chosen a winning grid location by comparing the selected locations 902 with the winning grid locations 903 for that game.

35

Referring now to Figure 12B, the central controller 101 sends the winning grid locations 903 to the user

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computer 102 (step 1251). In step 1252, the user  
computer 102 verifies the fairness of the game.  
Specifically, the cryptographic processor 302 of the  
user computer 102 applies the one-way hash function to  
5 the received winning grid locations to verify that the  
hash value 1101 given to him before sending his  
selection is equal to the new hash value calculated by  
applying the one-way hash function to the winning grid  
locations.

10

If the player has not won, the central controller 101  
proceeds to generate the next game (step 1270). If the  
player has won, the central controller 101 updates the  
total money awarded 707 in the customer database 211 to  
15 reflect the amount the player has just won (step 1260),  
and then generates the next game. In addition, at the  
end of a billing cycle, the central controller 101  
queries the customer database 211 to see if the  
customer is owed money (step 1280). If money is due  
20 the player, the central controller 101 initiates a  
payment to the customer according to customer's payment  
method preference 709 (step 1281).

It should be noted that in this embodiment the  
25 punchboard cannot be reused; it must be replaced with a  
fresh punchboard after each player selection. If the  
punchboard were not replaced, the player could continue  
to select grid locations after receiving the winning  
grid locations 903 (see step 1251). The player could,  
30 however, make more than one selection during a game  
session (see step 1204), as long as each selection was  
received by the central controller 101 before the  
winning locations were transmitted to the player.

35 With minor modifications, this embodiment of the  
invention can accommodate any number of players. By  
delaying the transmission of the winning grid locations

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until after all grid location selections have been received, any number of players can be accommodated with one punchboard. Alternatively, games could be conducted at great speed, preventing players from cheating by sharing winning locations. For example, two players might make selections on the same punchboard nearly simultaneously. The first player sends his grid location selection and then receives the winning grid locations. A fraction of a second later the second player sends his grid location selection. If the first player can communicate with the second player he can inform the second player of the winning grid locations, ensuring a win for the second player. If the time difference between the two plays is small enough, however, the first player will not have enough time to communicate the winning locations.

#### Third Embodiment (Hash Tree)

The third embodiment of the invention uses hash trees to accommodate multiple players in a single punchboard game. Details of hash tree techniques are well known in the art and for reference purposes are discussed in Merkle (U.S. Patent No. 4,309,569).

In this embodiment, each grid location is represented by  $(x, y, p, h_{xy})$ , where  $x$  and  $y$  are the coordinates,  $p$  is the prize associated with that location,  $h_{xy}$  is the hash value of that location, and  $h_{xy}$  is an aggregate hash value for all the other locations. Furthermore, a hash value,  $h$ , is calculated for the entire grid (including all locations) using hash function  $H$ . This function has the property  $H(h) = H(h_{xy}, h_{xy})$ . That is, the hash value for the entire grid is equal to the hash value of one location combined with the locations's  $h_{xy}$  value. For additional security, a random number may be



attached to each grid location to provide greater variation in the resulting hash values.

In this embodiment of the invention, the audit database  
5 311 in the user computer 102 has a structure as shown  
in Figure 13A. As in the previous embodiments, each  
record in the audit database corresponds to one game.  
A record includes the game identification number 901,  
selected grid location or locations 902, winning grid  
10 locations 903 and the game denomination 713, similar to  
the records shown in Figures 9A and 11A. In this  
embodiment, the record also includes the hash value  
1101 for all grid locations (both winning and losing),  
and an aggregate hash value 1301, representing the hash  
15 value of the aggregate of all the grid locations not  
selected by the player (i.e. the  $h_{xy}$  values of all the  
grid locations selected by the player).

The structure of the game database 212 in this  
20 embodiment is shown in Figure 13B. Each entry in the  
game database has a game identification number 901, a  
customer identification number 702 and the winning grid  
locations 903, as in the previous embodiments. The  
entry also has the user-selected grid location 902, the  
25 denomination 713 of the game, the hash value 1101 for  
all grid locations, and the aggregate hash value 1301.

A game conducted according to the third embodiment of  
the invention begins with the steps shown in the  
30 flowchart of Figure 8 as already described above, and  
continues with the steps shown in the flowcharts of  
Figures 14A, 14B and 14C.

In step 1401, the cryptoprocessor 202 of the central  
35 controller 101 retrieves the value of all grid  
locations of the game from the game database 212, and  
uses one-way hash function H stored in the memory (RAM

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204 or ROM 205) of the central controller to hash these grid locations, thereby generating  $h$ , the hash value 1101 (i.e. the hash value of all grid locations). The central controller 101 then (step 1402) distributes the hash value 1101 to the user computer 102, along with a "blank" punchboard 500 including the game identification number 510. The user computer 102 stores the hash value 1101 in the audit database 311 (step 1403). The player selects a grid location 902 and enters it into the user computer 102, using the input device 320 (step 1404). The player may enter additional selections if he so desires. After the player has made all of the selections for that game, a new record is entered in the audit database 311 of the user computer 102, reflecting the ID number for the game and the player's selected grid locations (step 1410). The user computer 102 then transmits the player's grid selections 902 and game ID number to the central controller 101 along with the game ID number (step 1411).

The central controller then (step 1451) queries the game database 212 to obtain the winning grid locations 903, to determine whether or not the player's grid selections correspond to the winning grid locations. The central controller 101 sends a message to the user computer 102 relating whether the player has won (step 1452).

The integrity of the game is verified in steps 1453 through 1457. Using the hash tree algorithm, the cryptoprocessor 202 of the central controller 101 generates (step 1453) an aggregate hash value 1301; this value is the hash value of the aggregate of all the grid locations that the player did not pick (i.e.  $h_{xy}$ ). The aggregate hash value 1301 is stored in the game database 212 of the central controller (step

1454). In step 1455, the central controller 101 sends the aggregate hash value 1301 to the user computer 102, which updates the aggregate hash value field of the audit database 311.

5

Using hash tree techniques, the cryptoprocessor 302 of the user computer 102 takes both the information relating to the prize value corresponding to the player's selection (i.e.  $h_{xy}$ ) and the aggregate hash  
10 value 1301 to calculate a hash value for the entire grid (step 1456). In step 1457, the user computer 102 uses hash tree techniques to compare this hash value for the entire grid to the hash value 1101 stored in the audit database 311. If the two values match, the  
15 integrity of the game is confirmed.

At this point, the player does not know the location of any winning locations on the grid, and therefore cannot help any other player to win. The winning grid  
20 locations are not revealed until all players have made all of their selections.

When all grid locations have been selected by all the players, the central controller 101 sends the winning  
25 grid locations to the user computer 102 (step 1458). The user computer stores the winning grid locations in the audit database 311 (step 1481). At the end of a billing cycle, the central controller 101 queries the customer database 211 to see if the customer is owed  
30 money (step 1482). If money is due the customer, the central controller 101 initiates a payment to the customer according to the customer's preferred payment method 709 (step 1483).

35

Fourth Embodiment (Central Controller Encryption)

In the fourth embodiment of the invention, the audit database 311 in the user computer 102 has a structure as shown in Figure 15A. As in the previous embodiments, each record in the audit database corresponds to one game. A record includes the game identification number 901, selected grid location or locations 902, and the game denomination 713. In this embodiment, the record also includes a random key 1510, and encrypted and decrypted versions (1520 and 1530 respectively) of the winning grid locations.

The structure of the game database 212 in this embodiment is shown in Figure 15B. Each entry in the game database has a game identification number 901, a customer identification number 702 and the winning grid locations 903, as in the previous embodiments. The entry also has the user-selected grid location 902, the game denomination 713 and the random key 1510.

A game conducted according to the fourth embodiment of the invention begins with the steps shown in the flowchart of Figure 8 as already described above, and continues with the steps shown in the flowchart of Figure 16.

In step 1601, the central controller 101 retrieves the winning grid locations 903 for a game from the game database 212; the cryptoprocessor 202 encrypts these locations using the random key 1510. The central controller 101 then transmits the encrypted grid locations to the user computer 102 along with the "blank" electronic game board (step 1602). The player enters his grid location selections into the user computer 102, using the input device 320 (step 1603). The user computer 102 transmits the player's grid

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location selection to the central controller along with the game ID number (step 1604). In step 1605, the central controller stores the player's selections in the selected grid locations field 902 of the game database 212, and then transmits the key 1510 to the user computer 102. The central controller 101 then (step 1606) compares the user selected grid locations 902 with the winning grid locations 903.

10 If the player is not a winner, the central controller proceeds to generate the next game (step 1650). If the player is a winner, the central controller 101 updates the total money awarded 707 in the customer database 211 to reflect the amount the player has just won (step 1610). In addition, at the end of a billing cycle, the central controller 101 queries the customer database 211 to see if the customer is owed money (step 1620). If money is due the player, the central controller 101 initiates a payment to the customer according to customer's payment method preference 709 (step 1630).

It should be noted that a key element of this embodiment is that the central controller 101 sends the winning grid locations to the user computer 102 (though encrypted and thus unreadable by the user computer) before receiving the user's grid location selection. The player is thereby assured that the game provider cannot change the winning locations based upon knowledge of his selection. On the other hand, the central controller holds the player's selection before the player is provided with the key to decrypt the winning locations. The encryption of the winning locations thus assures both parties that the game has been fairly conducted.

35

This embodiment is particularly applicable to games such as blackjack, in which the central controller

could randomly arrange an electronic deck of cards, encrypt them, and transmit them to the player. The player then sends card selections and play decisions to the central controller.

5

Fifth Embodiment (Trusted Third Party)

In the fifth embodiment of the invention, a trusted third party computer 400 is used to assure the integrity of the game. The audit database 311 in the user computer 102, the audit database 411 in the trusted third party computer 400 (both shown in Figure 17A) and the game database 212 in the central controller 212 (shown in Figure 17B) have the same structure. Each record in these databases corresponds to one game. A record includes the game identification number 901, selected grid location or locations 902, the winning grid locations 903, the game denomination 713 and the customer identification number 702.

20

A game conducted according to the fifth embodiment of the invention begins with the steps shown in the flowchart of Figure 8 as already described above, and continues with the steps shown in the flowcharts of Figures 18A and 18B. In step 1801, the central controller 101 transmits the game identification number 901 and the winning grid locations 903 to the trusted third party 400. The central controller 101 then sends a "blank" punchboard 500 to the user computer 102 (step 1802). The player selects a grid location 902 and enters it into the user computer 102, using the input device 320 (step 1803). The player may enter additional selections if he so desires. After the player has made all of the selections for that game, the user computer 102 transmits the player's grid selections 902 to the central controller 101 (step 1810). The central controller queries the winning grid

35

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location field 903 of the game database 212 to determine if the player's grid selection is a winner (step 1811). If the selection is a winner (step 1812), the controller notifies the player and updates the  
5 total money awarded field 707 of the customer database 211 accordingly.

The user computer 102 then transmits the game identification number to the trusted third party 400  
10 (step 1813). The CPU 401 of the third party computer 400 queries the game identification number field 901 of the audit database 411 and retrieves the requested game identification number (step 1814). The third party computer 400 then sends the winning grid locations  
15 corresponding to the requested game identification number to the user computer 102 (step 1815).

In step 1851, the player uses the information from the trusted third party 400 to verify that the game  
20 provided by the central controller 101 was legitimate. In this embodiment, the use of the trusted third party makes encryption of player selected grid locations and winning grid locations unnecessary.

25 At the end of a billing cycle, the central controller 101 queries the customer database 211 to see if the customer is owed money (step 1852). If money is due the player, the central controller 101 initiates a payment to the customer according to customer's payment  
30 method preference 709 (step 1853).

Many variations of the embodiments discussed above are possible. For example, the central controller can track the amount of play engaged in by individual users  
35 for marketing purposes. In particular, special advertisements could be transmitted over the Internet targeted to high volume players. The central

controller may offer demonstration games for new users so that they learn how to play. The game may be configured as a "pulltab" game, rather than punchboard. A user may be offered discounts on subsequent game, to  
5 provide him with an incentive to play again.

Although the above embodiments have been described with reference to a remote player making payments by credit card, a number of payment methods are possible. For  
10 example, the player may maintain an account with the game provider, or make payments with digital cash. Furthermore, rather than interact remotely with the central controller, the player may make his payment to a live cashier, who then enters the amount of credit  
15 into the central controller using an input device.

In addition, although the above embodiments have been described with reference to communication over the Internet, it will be appreciated that the practice of  
20 our invention is not limited to Internet communications, but is applicable to a variety of possible modes of communication between the game provider and the player. Commercial online services such as CompuServe and America Online could implement  
25 the systems and methods of the present invention.

Each of the above-described embodiments of the virtual punchboard is generally applicable to a game in which a player predicts a random outcome. One skilled in the  
30 art will appreciate how the various aspects of the virtual punchboard may be implemented in other games of chance (roulette, bingo, slot machines, blackjack, craps, lottery, etc.).

35 While the present invention has been described above in terms of specific embodiments, it is to be understood that the invention is not limited to the disclosed



embodiments. On the contrary, the present invention is intended to cover various modifications and equivalent structures included within the spirit and scope of the appended claims.

We claim:

1. A system for facilitating a computer-based game of  
5 chance, comprising:

a computing device including a processor, a  
cryptoprocessor connected to the processor and a memory  
device connected to the processor, the memory device  
containing a program, adapted to be executed by the  
10 processor, for transmitting a plurality of available  
game selections each identified by a unique selection  
identifier, receiving a player selection identified by  
a player selection identifier, transmitting a winning  
selection identifier, and comparing said player  
15 selection identifier with said winning selection  
identifier to determine a result of said game of  
chance,

wherein player selection identifier is encrypted,  
said computing device transmits the winning selection  
20 identifier in an unencrypted format after receiving the  
encrypted player selection identifier, said computing  
device receives the decryption key after transmitting  
the winning selection identifier, said computing device  
decrypts the encrypted player selection identifier  
25 using the cryptoprocessor and decryption key, and  
afterwards performs said comparing by comparing the  
decrypted player selection identifier with the winning  
selection identifier.

30 2. A system according to claim 1, wherein said game  
of chance comprises an electronically implemented  
punchboard.

3. A system according to claim 1, wherein said game  
35 of chance comprises an electronically implemented  
roulette wheel.

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4. A system according to claim 1, wherein said game of chance comprises an electronically implemented bingo game.
- 5 5. A system according to claim 1, wherein said game of chance comprises an electronically implemented slot machine.
6. A system according to claim 1, wherein said game  
10 of chance comprises an electronically implemented lottery.
7. A system according to claim 1, wherein said transmitting and receiving are performed on the  
15 Internet.
8. A system according to claim 1, wherein the memory device includes a game database containing the winning selection identifier and a prize amount associated  
20 therewith.
9. A system according to claim 1, wherein said computing device further comprises a random number generator for generating a random number for use in  
25 selecting the winning selection from the plurality of available selections.
10. A system according to claim 1, wherein the memory device includes a customer database containing a  
30 customer identifier and information regarding a credit account of a customer, and the program is further adapted to initiate a charge against the credit account in accordance with the player selection and to initiate a payment to the credit account of the prize amount in  
35 accordance with the result of said game.

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11. A system according to claim 1, wherein said encryption key and said decryption key are identical.

12. A system according to claim 1, wherein the  
5 encryption key is based on a random number.

13. A system for facilitating a computer-based game of chance, comprising:

a computing device including a processor, a  
10 cryptoprocessor connected to the processor and a memory device connected to the processor, the memory device containing a program, adapted to be executed by the processor, for transmitting a plurality of available game selections each identified by a unique selection  
15 identifier, receiving a player selection identified by a player selection identifier, transmitting a winning selection identifier, and comparing said player selection identifier with said winning selection identifier to determine a result of said game of  
20 chance,

wherein the cryptoprocessor generates a first value based on the winning selection identifier, and said computing device transmits the first value with the plurality of available game selections for  
25 comparison with a second value based on the transmitted winning selection identifier, the winning selection identifier transmitted after receipt of the player selection identifier, where said comparison is used to verify that the winning selection identifier and the  
30 player selection identifier were independently generated.

14. A system according to claim 13, wherein the first value and the second value are one-way hash values.

35

15. A system for facilitating a computer-based game of chance, comprising:

a computing device including a processor, a cryptoprocessor connected to the processor and a memory device connected to the processor, the memory device containing a program, adapted to be executed by the processor, for transmitting a plurality of available game selections each identified by a unique selection identifier, receiving a player selection identified by a player selection identifier, transmitting a winning selection identifier, and comparing said player selection identifier with said winning selection identifier to determine a result of said game of chance,

wherein the cryptoprocessor generates a first value based on the winning selection identifier, said computing device transmits the first value with the plurality of available game selections, the cryptoprocessor generates a second value based on the available game selections other than the player selection after said computing device receives the player selection identifier, and said computing device before transmitting the winning selection identifier transmits the second value, where comparison of a third value based on the player selection and the second value with the first value verifies that the winning selection identifier and the player selection identifier were independently generated.

16. A system according to claim 15, wherein the first value, the second value and the third value are one-way hash values, and the third value is generated using a hash tree algorithm.

17. A system for facilitating a computer-based game of chance, comprising:

a computing device including a processor, a cryptoprocessor connected to the processor and a memory device connected to the processor, the memory device

containing a program, adapted to be executed by the processor, for transmitting a plurality of available game selections each identified by a unique selection identifier, receiving a player selection identified by  
5 a player selection identifier, transmitting a winning selection identifier, and comparing said player selection identifier with said winning selection identifier to determine a result of said game of chance,

10 wherein the cryptoprocessor encrypts the winning selection identifier using a selected encryption key, said computing device transmits the encrypted winning selection identifier before receiving the player selection identifier, and said computing device  
15 transmits the selected encryption key after receiving the player selection.

18. A system according to claim 17, wherein said computing device transmits a digital signed encrypted  
20 winning selection identifier.

19. A system according to claim 17, wherein the encryption key is based on a random number.

25 20. A system for facilitating a computer-based game of chance, comprising:

a first computing device including a first processor and a first memory device connected to the first processor; and

30 a second computing device, including a second processor and a second memory device connected to the second processor,

the first memory device containing a first program, adapted to be executed by the first processor,  
35 for transmitting a plurality of available game selections each identified by a unique selection identifier, receiving a player selection identified by

a player selection identifier, transmitting a winning selection identifier, and comparing said player selection identifier with said winning selection identifier to determine a result of said game of chance,  
5 and

the second memory device containing a second program, adapted to be executed by the second processor, for receiving the winning selection identifier from said first computing device and transmitting the winning selection identifier after said first computing device receives the player selection identified by the player selection identifier.  
10

15

21. A system for facilitating a computer-based game of chance, comprising:

a first computing device including a first processor, a first cryptoprocessor connected to the first processor and a first memory device connected to the first processor, the first memory device containing a first program, adapted to be executed by the first processor, for transmitting a plurality of available game selections each identified by a unique selection identifier, receiving a player selection identified by a player selection identifier, transmitting a winning selection identifier, and comparing said player selection identifier with said winning selection identifier to determine a result of said game of chance;  
20  
25  
30 and

a second computing device, including a second processor, a second cryptoprocessor connected to the second processor and a second memory device connected to the second processor, the second memory device containing a second program, adapted to be executed by the second processor, for receiving the plurality of available game selections from said first computing  
35

device, transmitting to the first computing device the player selection identified by the player selection identifier, and receiving the winning selection identifier from the first computing device.

5

22. A method of generating and verifying results of a computer-based game of chance, the method comprising the steps of:

transmitting to a player computer a plurality of  
10 available game selections each identified by a unique selection identifier;

receiving from said player computer a player selection identified by a player selection identifier;

transmitting to said player computer a winning  
15 selection identifier;

comparing said player selection identifier with said winning selection identifier to determine if said player has won said game of chance; and

verifying that said winning selection identifier  
20 and said player selection identifier were independently generated.

23. A method of generating and verifying results of a computer-based game of chance, the method comprising  
25 the steps of:

a first transmitting step of transmitting to a player computer a plurality of available game selections each identified by a unique selection identifier;

30 a first receiving step of receiving from said player computer an encrypted player selection using a selected encryption key to generate an encrypted player selection identifier;

transmitting, after said first receiving step, to  
35 said player computer a winning selection identifier in an unencrypted format;



comparing said player selection identifier with said winning selection identifier to determine if said player has won said game of chance;

5 a second receiving step of receiving from said player computer said selected encryption method;

decrypting said encrypted selected selection identifier using said selected encryption key; and

10 comparing the decrypted player selection identifier with said winning selection identifier to verify that said player has won said game of chance.

24. A method according to claim 22, wherein said game of chance comprises an electronically implemented punchboard.

15

25. A method according to claim 22, wherein said game of chance comprises an electronically implemented roulette wheel.

20 26. A method according to claim 22, wherein said game of chance comprises an electronically implemented bingo game.

25 27. A method according to claim 22, wherein said game of chance comprises an electronically implemented slot machine.

30 28. A method according to claim 22, wherein said game of chance comprises an electronically implemented lottery.

29. A method according to claim 22, wherein said transmitting and receiving are performed on an electronic network.

35

30. A method according to claim 29, wherein said electronic network includes a commercial online service provider

5 31. A method according to claim 22, wherein the selected encryption key is based on a random number.

32. A method for generating and verifying results of a computer-based game of chance, the method comprising  
10 the steps of:

generating a winning selection identifier and a first value based thereon;

transmitting to a player computer the first value and a plurality of available game selections each  
15 identified by a unique selection identifier;

receiving from said player computer a player selection identified by a player selection identifier;

transmitting the winning selection identifier to said player computer after receiving said player  
20 selection identifier;

comparing said player selection identifier with said winning selection identifier to determine a result of said game of chance; and

said first value for comparison with a second  
25 value based on said transmitted winning selection identifier to verify that the winning selection identifier and the player selection identifier were independently generated.

30 33. A method according to claim 32, wherein the first value and the second value are one-way hash values.

34. A method of generating and verifying results of a computer-based game of chance, the method comprising  
35 the steps of:

generating a winning selection identifier and a first value based thereon;

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transmitting to a player computer the first value and a plurality of available game selections each identified by a unique selection identifier;

receiving from said player computer a player  
5 selection identified by a player selection identifier;

generating, after said receiving step, a second value based on the available game selections other than the player selection;

transmitting the second value to said player  
10 computer;

transmitting a winning selection identifier, after said step of transmitting the second value;

generating a third value based on the player selection and the second value;

15 comparing said player selection identifier with said winning selection identifier to determine a result of said game of chance; and

comparing the third value with the first value to verify that the winning selection identifier and the  
20 player selection identifier were independently generated.

35. A method according to claim 34, wherein the first value, the second value and the third value are one-way  
25 hash values, and the third value is generated using a hash tree algorithm.

36. A method of generating and verifying results of a computer-based game of chance, the method comprising  
30 the steps of:

transmitting to a player computer a plurality of available game selections each identified by a unique selection identifier;

encrypting a winning selection identifier using a  
35 selected encryption key;

transmitting the encrypted winning selection identifier to said player computer;

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receiving, after said step of transmitting the encrypted winning selection identifier, a player selection identified by a player selection identifier;

transmitting, after said step of receiving the  
5 player selection, the selected encryption key to said player computer; and

comparing said player selection identifier with said winning selection identifier to determine a result of said game of chance.

10

37. A method according to claim 36, wherein said step of transmitting the encrypted selection identifier includes digitally signing said encrypted selection identifier.

15

38. A method according to claim 36, wherein the encryption key is based on a random number.

39. A method of generating and verifying results of a  
20 computer-based game of chance, the method comprising the steps of:

transmitting to a player computer a plurality of available game selections each identified by a unique selection identifier;

25 transmitting to a third-party computer a winning selection identifier;

receiving, after said step of transmitting the winning selection identifier, from said player computer a player selection identified by a player selection  
30 identifier;

transmitting, after said receiving step, the winning selection identifier to said player computer; and

comparing said player selection identifier with  
35 said winning selection identifier to determine a result of said game of chance.

40. A device for facilitating a game of chance, comprising:

- 5 a first computing device including a first processor, a first cryptoprocessor connected to the first processor and a first memory device connected to the first processor and containing a first program and a database containing information regarding a player of said game and a distribution of prizes for said game; and
- 10 a second computing device including a second processor, a second cryptoprocessor connected to the second processor, a second memory device connected to the second processor and containing a second program and a database containing information regarding game
- 15 selections made by the player during said game, an input device connected to the second processor for inputting the game selections, and a display device connected to the second processor for displaying a result of said game,
- 20 the first program being adapted to be executed by the first processor for transmitting a plurality of available game selections each identified by a unique selection identifier, receiving a player selection identified by a player selection identifier,
- 25 transmitting a winning selection identifier, and comparing said player selection identifier with said winning selection identifier to determine the result of said game, and
- 30 the second program being adapted to be executed by the second processor for receiving the plurality of available game selections from said first computing device, transmitting to the first computing device the player selection identified by the player selection identifier, and receiving the winning selection
- 35 identifier from the first computing device.

41. A device according to claim 40, wherein said first computing device and said second computing device each further comprise means for communicating on the Internet.

5

42. A device according to claim 40, wherein said first computing device further comprises a first random number generator for generating a random number used by the first cryptoprocessor, and said second computing  
10 device further comprises a second random number generator for generating a random number used by the second cryptoprocessor.

43. A computer readable medium in which is stored  
15 computer readable code to be executed by a computer, said computer readable code performing a method of generating and verifying results of a computer-based game of chance, the method comprising the steps of:

transmitting to a player computer a plurality of  
20 available game selections each identified by a unique selection identifier;

receiving from said player computer a player selection identified by a player selection identifier;

transmitting to said player computer a winning  
25 selection identifier;

comparing said player selection identifier with said winning selection identifier to determine if said player has won said game of chance; and

verifying that said winning selection identifier  
30 and said player selection identifier were independently generated.

44. A computer readable medium according to claim 43, wherein communication between said computer and said  
35 player computer is performed on the Internet.

45. A method of participating in a computer-based game of chance, comprising the steps of:

receiving a plurality of available game selections each identified by a unique selection identifier;

5 transmitting a player selection identified by a player selection identifier;

receiving a winning selection identifier identifying a winning selection; and

10 verifying that the winning selection identifier and the player selection identifier were independently generated.

46. A system for facilitating a computer-based game of chance, comprising:

15 a computing device including a processor, a cryptoprocessor connected to the processor, an input device connected to the processor, a display device connected to the processor and a memory device connected to the processor, the memory device  
20 containing a program, adapted to be executed by the processor, for receiving a plurality of available game selections each identified by a unique selection identifier, receiving a player selection identified by a player selection identifier input from the input  
25 device, encrypting the player selection identifier using the cryptoprocessor according to an encryption key, transmitting the encrypted player selection identifier, receiving a winning selection identifier, transmitting the encryption key, comparing the player  
30 selection identifier with the winning selection identifier and displaying on the display device a result of said game of chance,

wherein said computing device receives the winning selection identifier in an unencrypted format after  
35 transmitting the encrypted player selection identifier, transmits the encryption key after receiving the

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winning selection identifier, and performs said comparing to verify the result of said game of chance.

47. A system for facilitating a computer-based game of chance, comprising:

a computing device including a processor, a cryptoprocessor connected to the processor, an input device connected to the processor, a display device connected to the processor and a memory device connected to the processor, the memory device containing a program, adapted to be executed by the processor, for receiving a plurality of available game selections each identified by a unique selection identifier and a first value based on a winning selection identifier, storing the first value in the memory device, receiving a player selection identified by a player selection identifier input from the input device, transmitting the player selection identifier, receiving the winning selection identifier, generating a second value using the cryptoprocessor based on the received winning selection identifier, comparing said first value with said second value and displaying on the display device a result of said game of chance, wherein the result of said game of chance is based on a comparison of the player selection identifier with the winning selection identifier, and said computing device compares said first value with said second value to verify that the winning selection identifier and the player selection identifier were independently generated.

48. A system for facilitating a computer-based game of chance, comprising:

a computing device including a processor, a cryptoprocessor connected to the processor, an input device connected to the processor, a display device connected to the processor and a memory device



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connected to the processor, the memory device containing a program, adapted to be executed by the processor, for receiving a plurality of available game selections each identified by a unique selection identifier and a first value based on a winning selection identifier, storing the first value in the memory device, receiving a player selection identified by a player selection identifier input from the input device, transmitting the player selection identifier, receiving a second value based on the available game selections other than the player selection, generating a third value based on the player selection and the second value using the cryptoprocessor, comparing the third value with the first value, receiving the winning selection identifier, and displaying on the display device a result of said game of chance,

wherein the result of said game of chance is based on a comparison of the player selection identifier with the winning selection identifier, said computing device receives the second value before receiving the winning selection identifier, and said computing device compares the third value with the first value to verify that the winning selection identifier and the player selection identifier were independently generated.

25

49. A system for facilitating a computer-based game of chance, comprising:

a computing device including a processor, a cryptoprocessor connected to the processor, an input device connected to the processor, a display device connected to the processor and a memory device connected to the processor, the memory device containing a program, adapted to be executed by the processor, for receiving a plurality of available game selections each identified by a unique selection identifier, receiving a player selection identified by a player selection identifier input from the input

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device, receiving a winning selection identifier in an encrypted format, transmitting the player selection identifier, receiving an encryption key, decrypting the encrypted winning selection identifier using the  
5 cryptoprocessor and the encryption key, and displaying on the display device a result of said game of chance, wherein said computing device receives the encrypted winning selection identifier before transmitting the player selection identifier and  
10 receives the encryption key after transmitting the player selection identifier, and the result of said game of chance is based on a comparison of the player selection identifier with the winning selection identifier.

15

50. A system for facilitating a computer-based game of chance, comprising:

a first computing device including a first processor, an input device connected to the first  
20 processor, a display device connected to the first processor and a first memory device connected to the first processor; and

a second computing device, including a second processor and a second memory device connected to the  
25 second processor,

the first memory device containing a first program, adapted to be executed by the first processor, for receiving a plurality of available game selections each identified by a unique selection identifier,  
30 receiving a player selection identified by a player selection identifier input from the input device, transmitting the player selection identifier, receiving a winning selection identifier from said second computing device, and displaying on the display device  
35 a result of said game of chance, and

the second memory device containing a second program, adapted to be executed by the second

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processor, for transmitting the winning selection identifier to said first computing device after said first computing device transmits the player selection identifier,

5        wherein the result of said game of chance is based on a comparison of the player selection identifier with the winning selection identifier.

51. A method of generating and verifying results of a  
10 computer-based game of chance, the method comprising the steps of:

receiving a plurality of available game selections each identified by a unique selection identifier;

15 inputting a player selection identified by a player selection identifier;

encrypting the player selection identifier using an encryption key;

transmitting the encrypted player selection identifier;

20 receiving a winning selection identifier;

comparing the player selection identifier with the winning selection identifier to determine if said player has won said game of chance; and

transmitting the encryption key,

25 wherein the winning selection identifier is received in an unencrypted format after the encrypted player selection identifier is transmitted, the encryption key is transmitted after the winning selection identifier is received, and a comparison of  
30 the player selection identifier with the winning selection identifier verifies that said player has won said game of chance.

52. A method of generating and verifying results of a  
35 computer-based game of chance, the method comprising the steps of:

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- receiving a plurality of available game selections each identified by a unique selection identifier and a first value based on a winning selection identifier;  
inputting a player selection identified by a  
5 player selection identifier;  
transmitting the player selection identifier;  
receiving the winning selection identifier;  
generating a second value based on the received winning selection identifier; and  
10 comparing said first value with said second value to verify that the winning selection identifier and the player selection identifier were independently generated.
- 15 53. A method of generating and verifying results of a computer-based game of chance, the method comprising the steps of:  
receiving a plurality of available game selections each identified by a unique selection identifier and a  
20 first value based on a winning selection identifier;  
inputting a player selection identified by a player selection identifier;  
transmitting the player selection identifier;  
receiving a second value based on the available  
25 game selections other than the player selection;  
generating a third value based on the player selection and the second value;  
comparing the third value with the first value;  
and  
30 receiving the winning selection identifier;  
wherein the second value is received before the winning selection identifier is received, and said step of comparing the third value with the first value verifies that the winning selection identifier and the  
35 player selection identifier were independently generated.

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54. A method of generating and verifying results of a computer-based game of chance, the method comprising the steps of:

- receiving a plurality of available game selections
- 5 each identified by a unique selection identifier;
- inputting a player selection identified by a player selection identifier;
- receiving a winning selection identifier in an encrypted format;
- 10 transmitting the player selection identifier;
- receiving an encryption key; and
- decrypting the encrypted winning selection identifier in accordance with the encryption key,
- wherein the encrypted winning selection identifier
- 15 is received before the player selection identifier is transmitted, the encryption key is received after the player selection identifier is transmitted, and a comparison of the player selection identifier with the winning selection identifier decrypted according to the
- 20 encryption key verifies that said player has won said game of chance.

55. A method of generating and verifying results of a computer-based game of chance, the method comprising

25 the steps of:

- receiving from a game server computer a plurality of available game selections each identified by a unique selection identifier;
- inputting a player selection identified by a
- 30 player selection identifier;
- transmitting the player selection identifier to the game server computer; and
- receiving from a third-party computer a winning selection identifier,
- 35 wherein the winning selection identifier is received from the third-party computer after said step of transmitting the player selection identifier.

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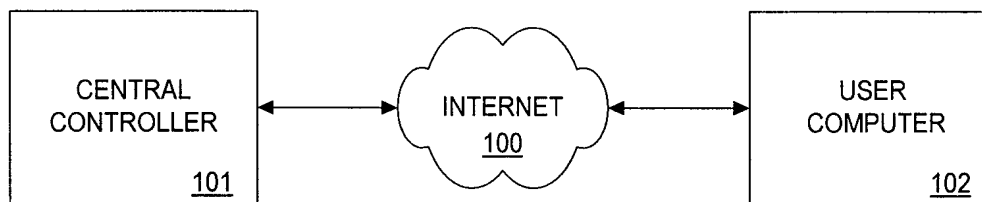


FIG. 1

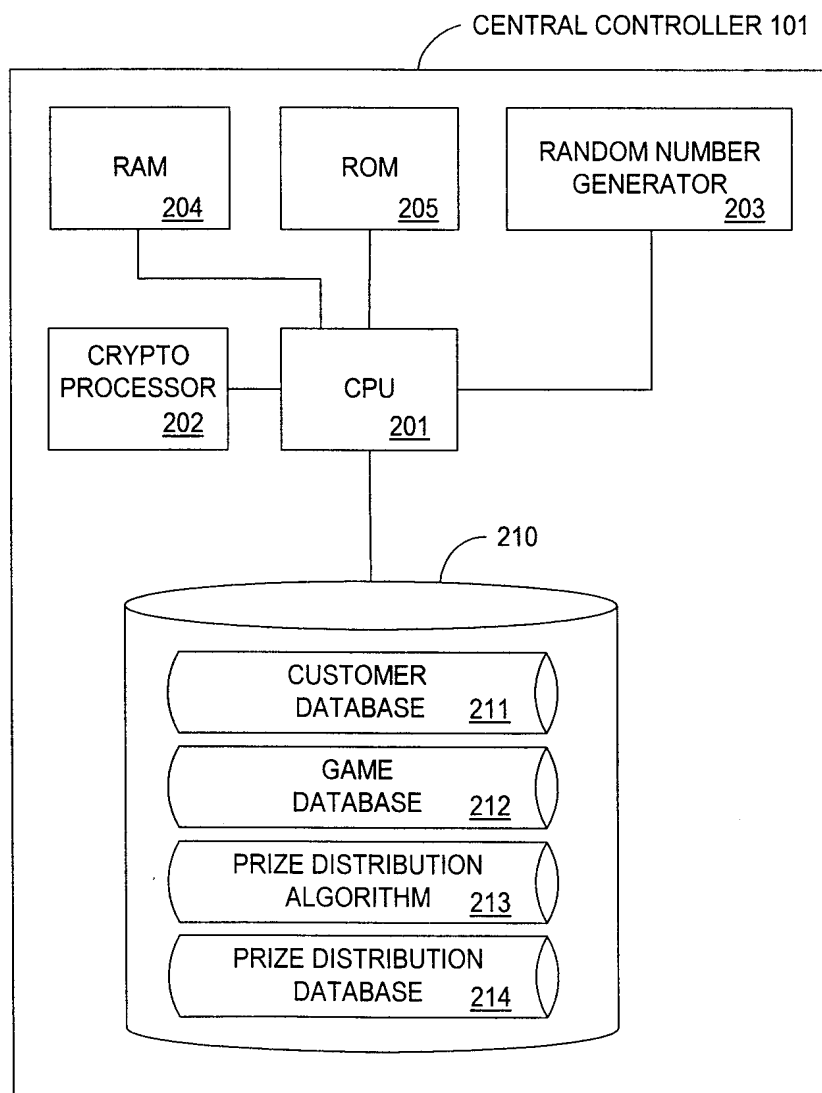


FIG. 2

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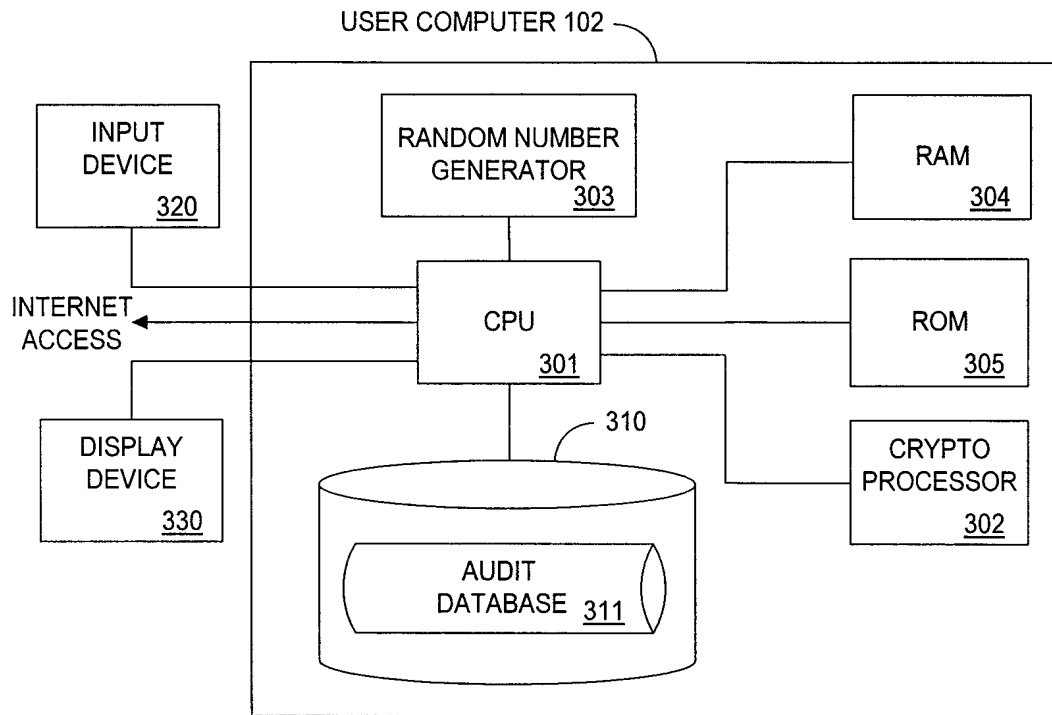


FIG. 3

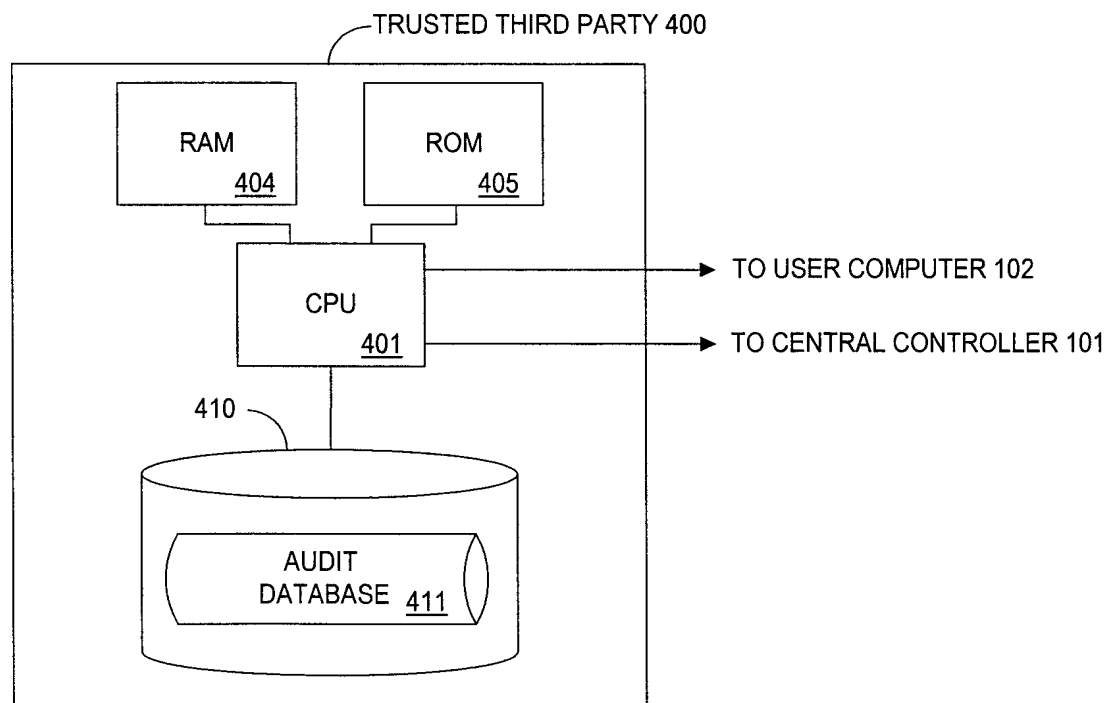


FIG. 4

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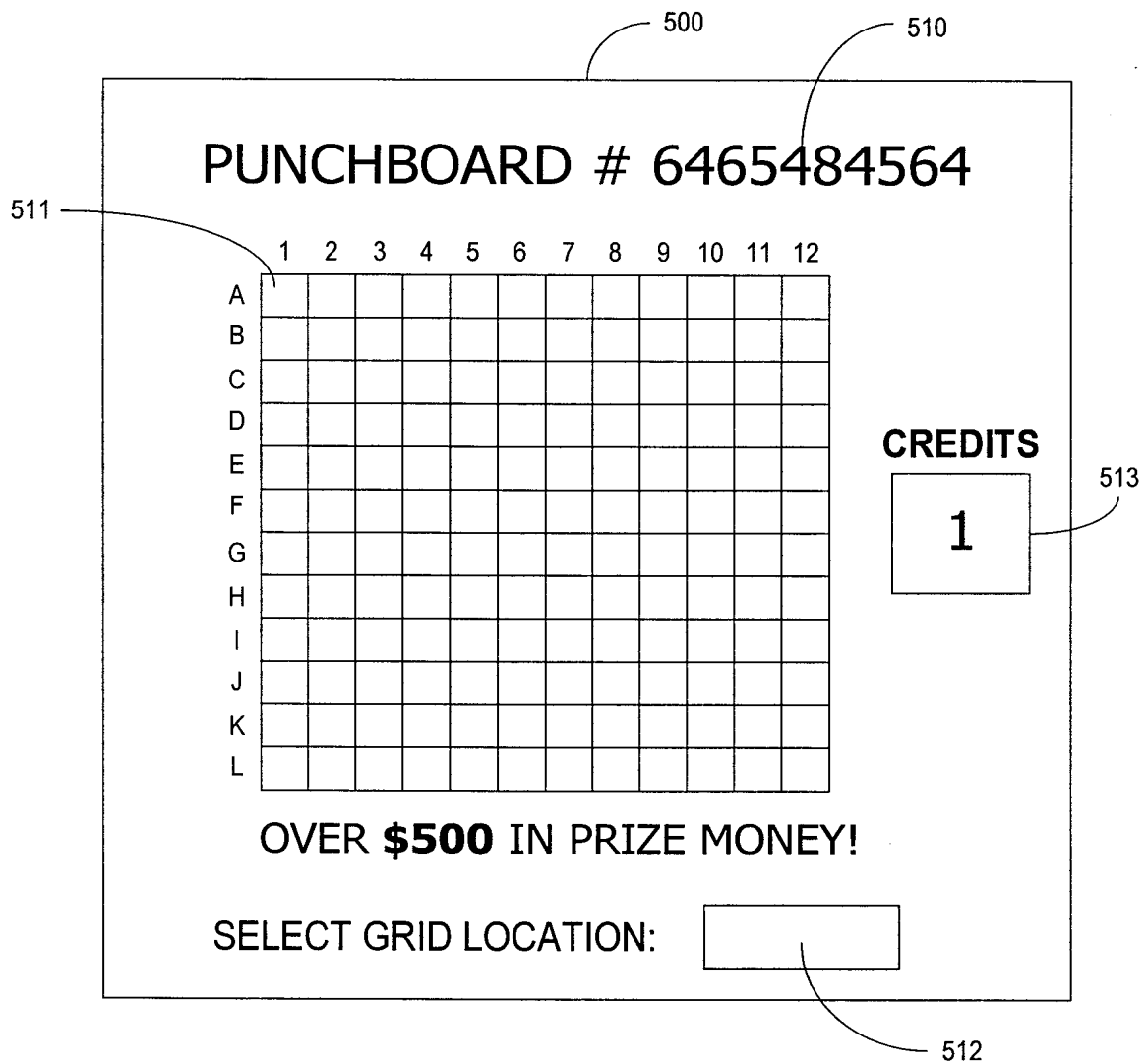


FIG. 5



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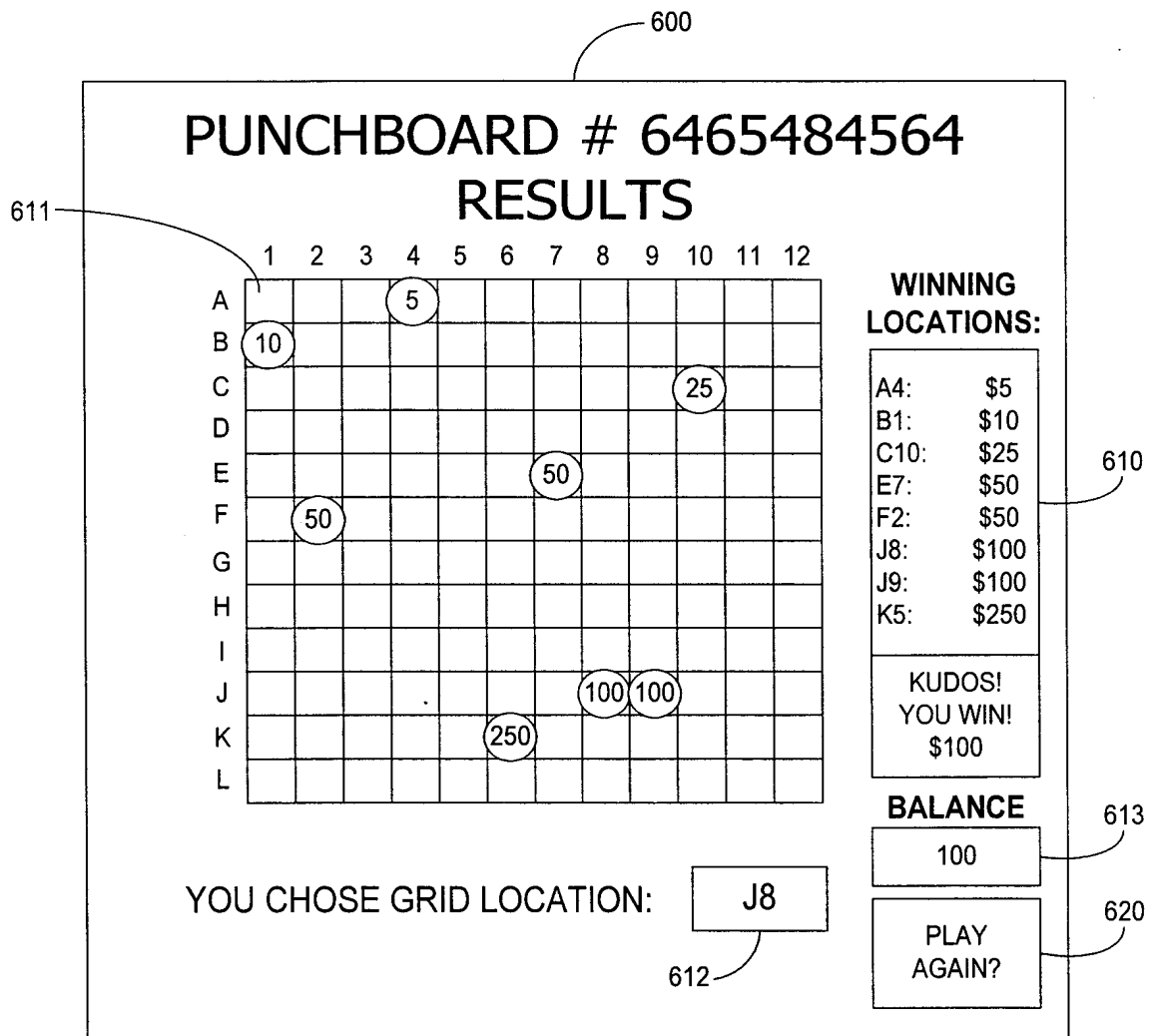


FIG. 6

CUSTOMER DATABASE 211

CUSTOMER NAME 701	CUSTOMER ID NUMBER 702	CREDIT CARD NUMBER 703	CUSTOMER E-MAIL ADDRESS 704
BILL SMITH	4588	6465 4645 6546 5648	SMITH@AOL.COM
ANGEL STAR	4544	6546 5465 4688 4589	ANGEL@UNIVERSITY.EDU
JOE BEAD	4321	0103 1831 8555 1215	JBEAD@WIDGET.COM

CUSTOMER ADDRESS 705	TOTAL MONEY SPENT 706	TOTAL MONEY AWARDED 707	SELECTION PREFERENCES 708	PRIZE AWARD PAYMENT PREFERENCE 709
4 RED ST.	\$75.00	\$100.00	J8	CHECK BY MAIL
6 BLUE RD.	\$15.00	\$0.00	A4, B4, C4, D4	TRANSFER TO CREDIT CARD ACCOUNT
87 PINK LN.	\$36.00	\$350.00	NONE	CHECK BY MAIL

FIG. 7A

PRIZE DISTRIBUTION DATABASE 214



PRIZE DISTRIBUTION IDENTIFICATION NUMBER	GRID SIZE	DENOMINATION	PRIZE ALLOCATION
<u>711</u>	<u>712</u>	<u>713</u>	<u>714</u>
001	10 X 10	\$1.00	\$50, \$5, \$10, \$25, \$50, \$100, \$25, \$5
002	20 X 30	\$3.00	\$5, \$10, \$25, \$50, \$50, \$100, \$100, \$250
003	30 X 30	\$5.00	\$100, \$25, \$50, \$100, \$100, \$250, \$500, \$5
004	30 X 30	\$5.00	\$1,000, \$500, \$500, \$250, \$250, \$100, \$100, \$100, \$50, \$50, \$25, \$15, \$5, \$5

FIG. 7B

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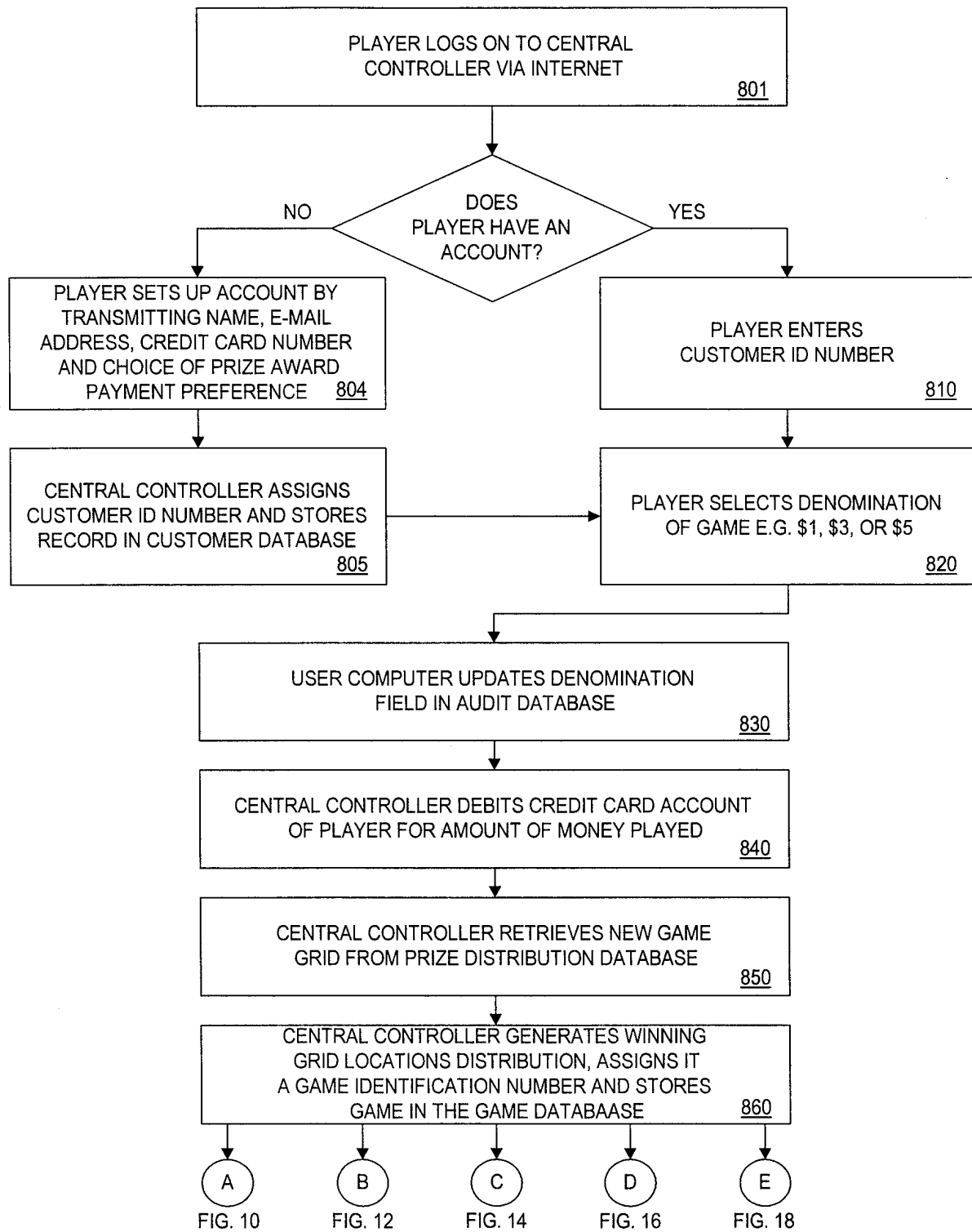


FIG. 8

AUDIT DATABASE 311



GAME IDENTIFICATION NUMBER 901	SELECTED GRID LOCATION(S) 902	WINNING GRID LOCATIONS 903	DENOMINATION 713	PLAYER KEY 904
6465484564	J8	A4 \$5, B1 \$10, C10 \$25, E7 \$50, F2 \$50, J8 \$100, J9 \$100, K5 \$250	\$3.00	11000101011010 01101101011...
6465486546	A4, I2, K1	A5 \$100, D7 \$25, E8 \$25, E9 \$100, F7 \$100, G3 \$250, G6 \$500, G7 \$5	\$5.00	1100011001111 01011010101...
6214563168		A1 \$50, C7 \$5, B7 \$10, E9 \$50, F1 \$100, G4 \$25, G9 \$5, H1 \$25	\$1.00	

FIG. 9A

GAME DATABASE 212

<div>GAME IDENTIFICATION NUMBER</div> <div>901</div>	<div>CUSTOMER ID NUMBER</div> <div>702</div>	<div>WINNING GRID LOCATION</div> <div>903</div>	<div>ENCRYPTED GRID LOCATION</div> <div>910</div>	<div>DECRYPTED GRID LOCATION</div> <div>920</div>	<div>PLAYER KEY</div> <div>930</div>
6465484564	4588	A4 \$5, B1 \$10, C 10 \$25, E7 \$50, J8 \$100, J9 \$100, K5 \$250	AS498DF...	J8	101010101111011...
6465484565	4544	A2 \$5, B3 \$10, B4 \$100, D6 \$250, D7 \$25, E2 \$50, G1 \$50	ADSFU90A8 FLDJ0D...		
	4321	A9 \$100, C5 \$50, D1 \$100,E9 \$25, F5 \$25, G4 \$50, G8 \$25, H1 \$250			
		A8 \$25, B3 \$50, C1 \$5, D2 \$10, G4 \$100, H6 \$250, J11 \$25, K3 \$100			

FIG. 9B

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FROM FIG. 8

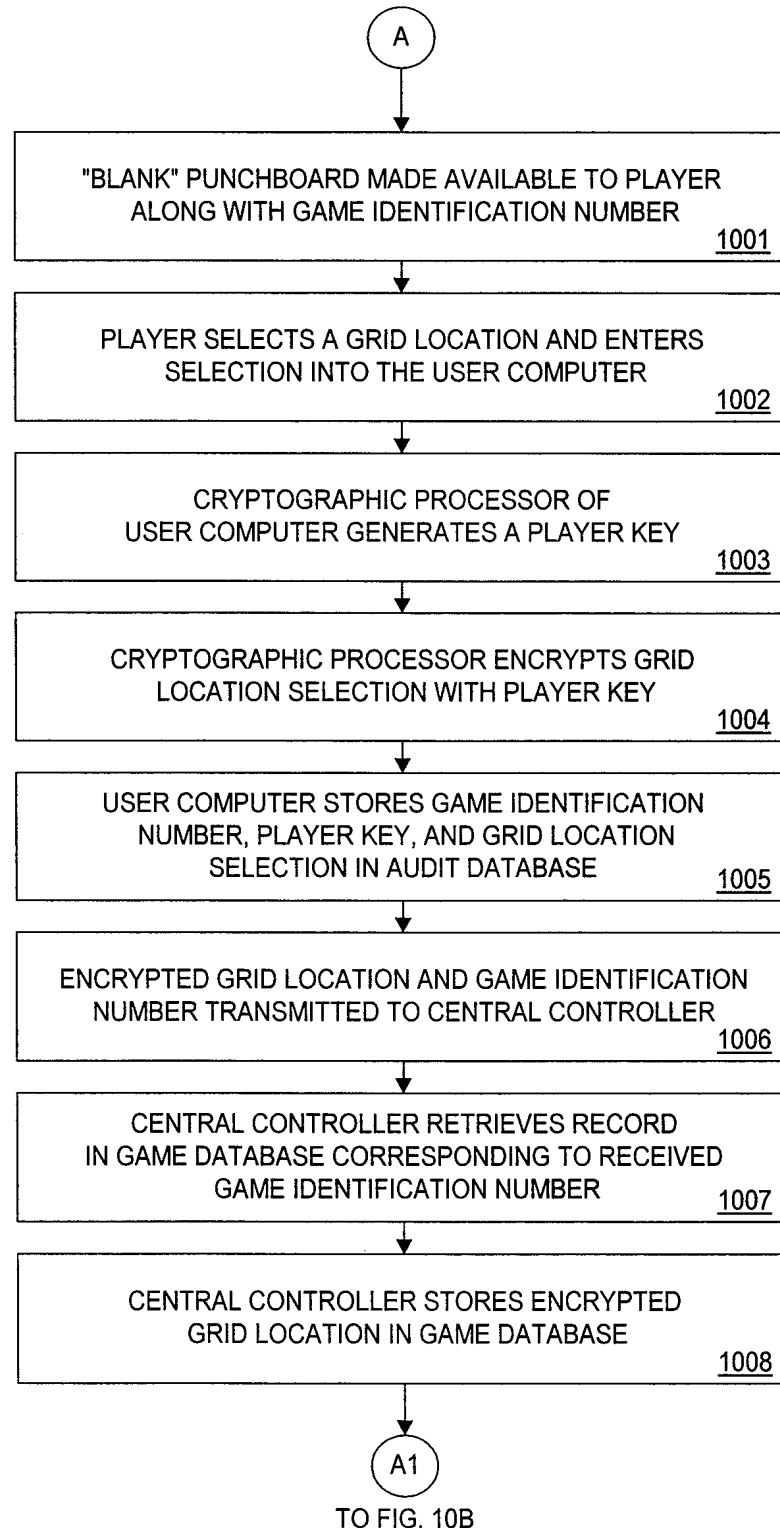


FIG. 10A

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FROM FIG. 10A

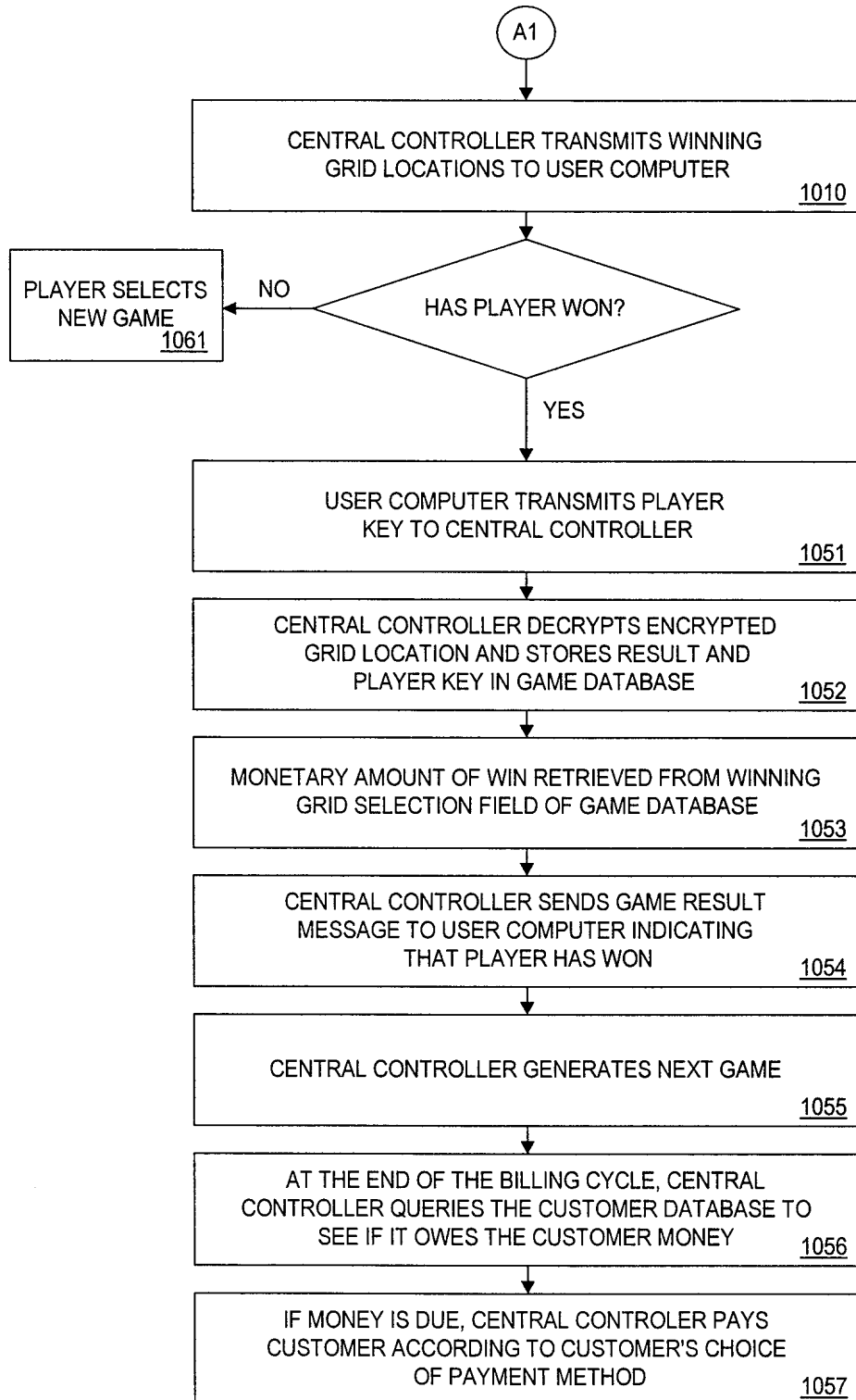


FIG. 10B



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AUDIT DATABASE 311  
↓

GAME IDENTIFICATION NUMBER	SELECTED GRID LOCATION	WINNING GRID LOCATIONS	DENOMINATION	HASH OF WINNING GRID LOCATIONS
901	902	903	713	1101
6465484564	J8	A4 \$5, B1 \$10, C10 \$25, E7 \$50, F2 \$50, J8 \$100, J9 \$100, K5 \$250	\$3.00	10100001101 1011010111...
6465486546	A4, I2, K1		\$5.00	101010111110 10110110101...
6215467168			\$1.00	101001101011 10101101011...
6215463175			\$3.00	

FIG. 11A

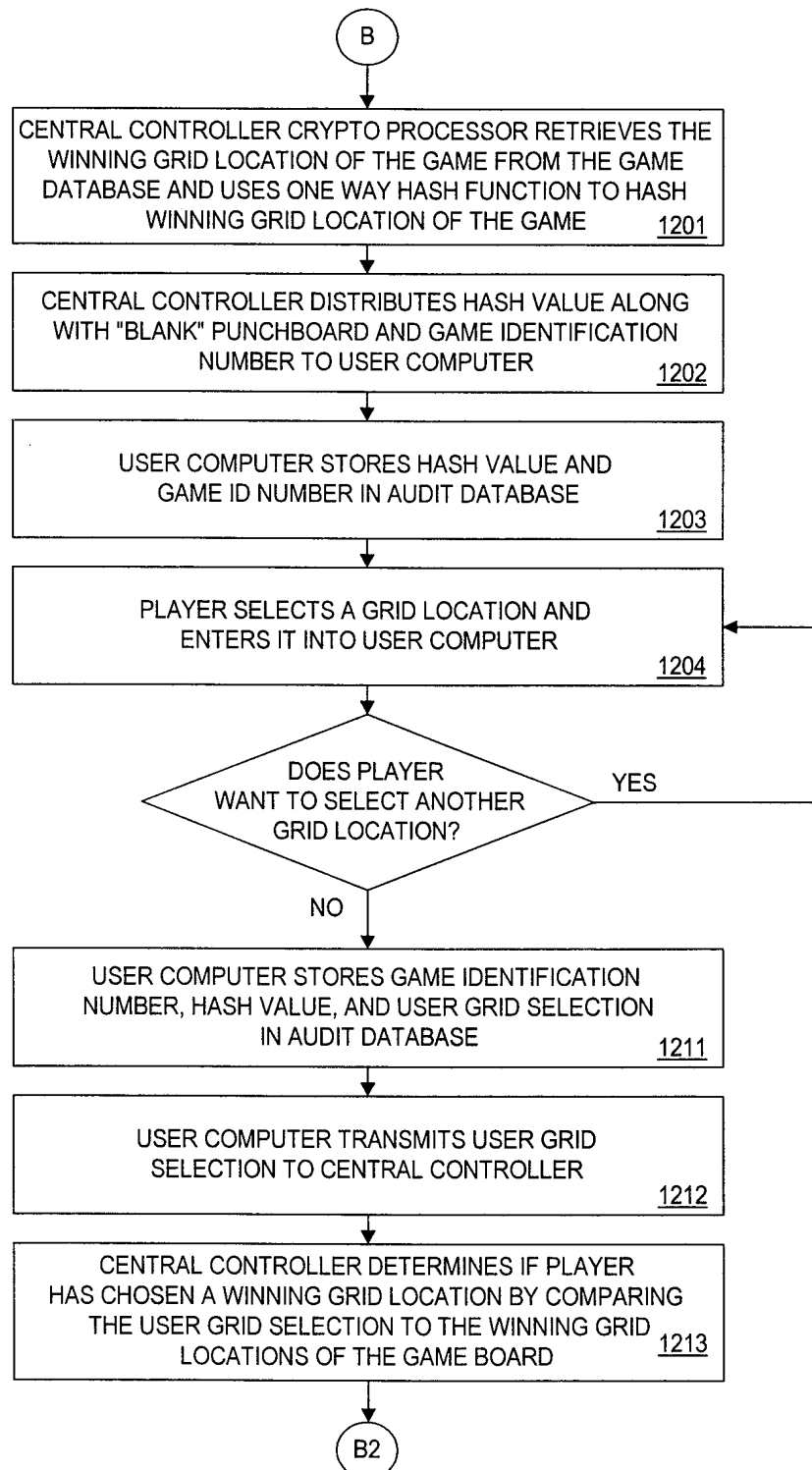
GAME DATABASE 212

GAME IDENTIFICATION NUMBER 901	CUSTOMER ID NUMBER 702	WINNING GRID LOCATIONS 903	USER GRID SELECTION 902	HASH OF WINNING GRID LOCATION 1101
6465484564	4588	A4 \$5, B1 \$10, C10 \$25, E7 \$50, F2 \$50, J8 \$100, J9 \$100, K5 \$250	J8	101000111010...
6465484565	4544	A2 \$5, B3 \$10, B4 \$100, D6 \$250, D7 \$25, E2 \$50, G1 \$50		101010111110...
6465484566	4321	A9 \$100, C5 \$50, D1 \$100, E9 \$25, F5 \$25, G4 \$50, G8 \$25, H1 \$250		
64654845667		A8, \$25, B3 \$\$\$50, C1 \$5, D2 \$10, G4 \$100,H6 \$250, J11, \$25, K3 \$100		

FIG. 11B

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FROM FIG. 8



TO FIG. 12B

FIG. 12A

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FROM FIG. 12A

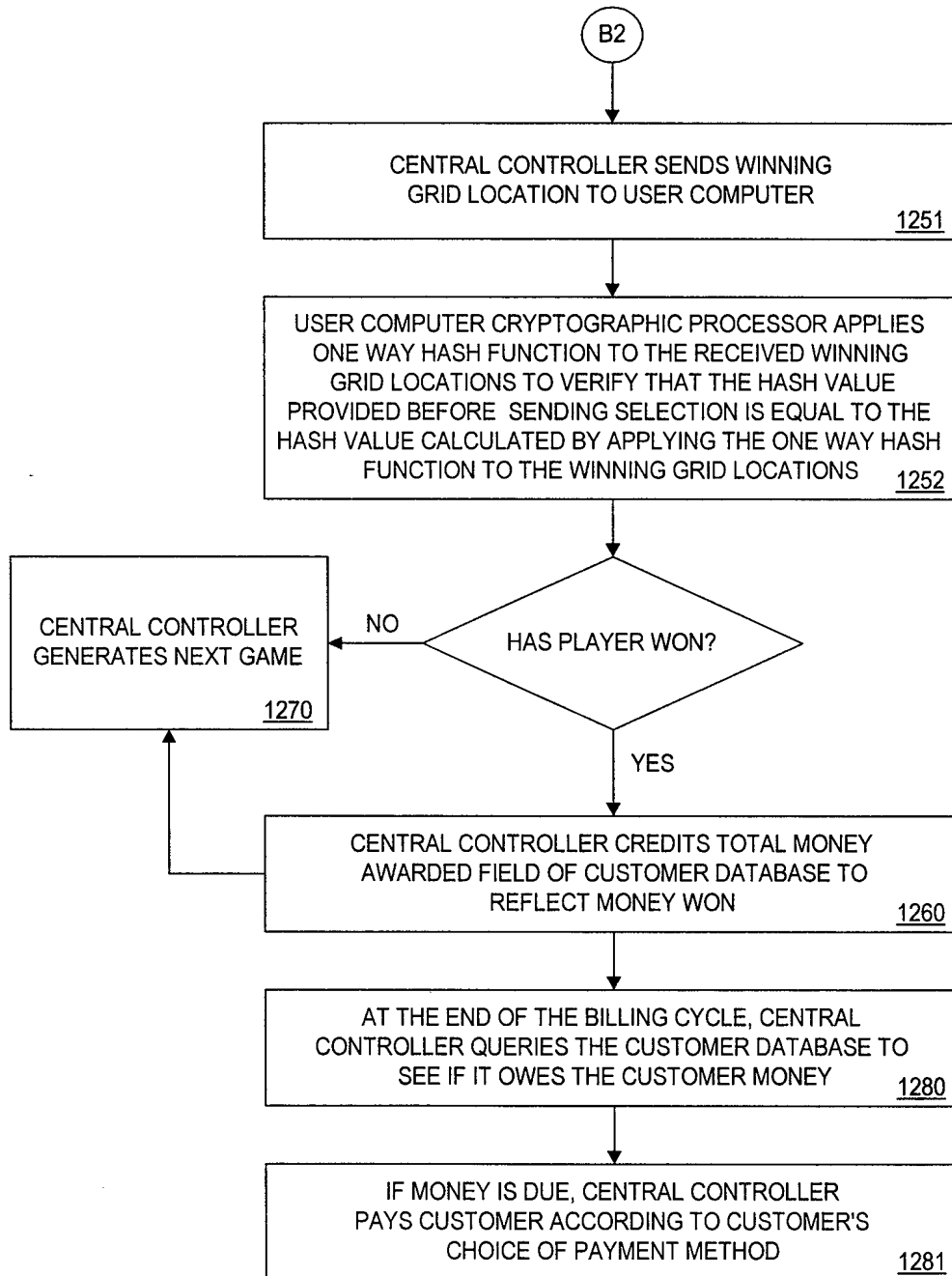


FIG. 12B

AUDIT DATABASE 311

GAME IDENTIFICATION NUMBER	SELECTED GRID LOCATION	WINNING GRID LOCATIONS	DENOMINATION	HASH VALUE OF ALL GRID LOCATIONS	AGGREGATE HASH VALUE
901	902	903	713	1101	1301
6465484564	J8	A4 \$5, B1 \$10, C10 \$25, E7 \$50, F2 \$50, J8 \$100, J9 \$100, K5 \$250	\$3.00	101000011101 1011010111...	101001000100 0111101011...
6465486546	A4, I2, K1		\$5.00	1010101111101 0110110101...	
6215467168			\$1.00	101001101011 10101101011...	
621543175			\$3.00		

FIG. 13A

GAME DATABASE 212

GAME IDENTIFICATION NUMBER	CUSTOMER ID NUMBER	WINNING GRID LOCATIONS	USER SELECTED GRID LOCATIONS	HASH VALUE OF ENTIRE GRID	AGGREGATE HASH VALUE	DENOMINATION
<u>901</u>	<u>702</u>	<u>903</u>	<u>902</u>	<u>1101</u>	<u>1301</u>	<u>713</u>
6465484564	4588	A4 \$5, B1 \$10, C10 \$25, E7 \$50, F2 \$50, J8 \$100, J9 \$100, K5 \$250	J8	101000111010...	10100100010 0110011110...	\$3.00
6465484564	4589	A4 \$5, B1 \$10, C10 \$25, E7 \$50, F2 \$50, J8 \$100, J9 \$100, K5 \$250	C2	1010101111110...	10100000111 1101110000...	\$3.00
6465484564	3218	A4 \$5, B1 \$10, C10 \$25, E7 \$50, F2 \$50, J8 \$100, J9 \$100, K5 \$250	C12, D13	101001101011...		\$3.00
6465484564		A4 \$5, B1 \$10, C10 \$25, E7 \$50, F2 \$50, J8 \$100, J9 \$100, K5 \$250				\$3.00

FIG. 13B

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FROM FIG. 8

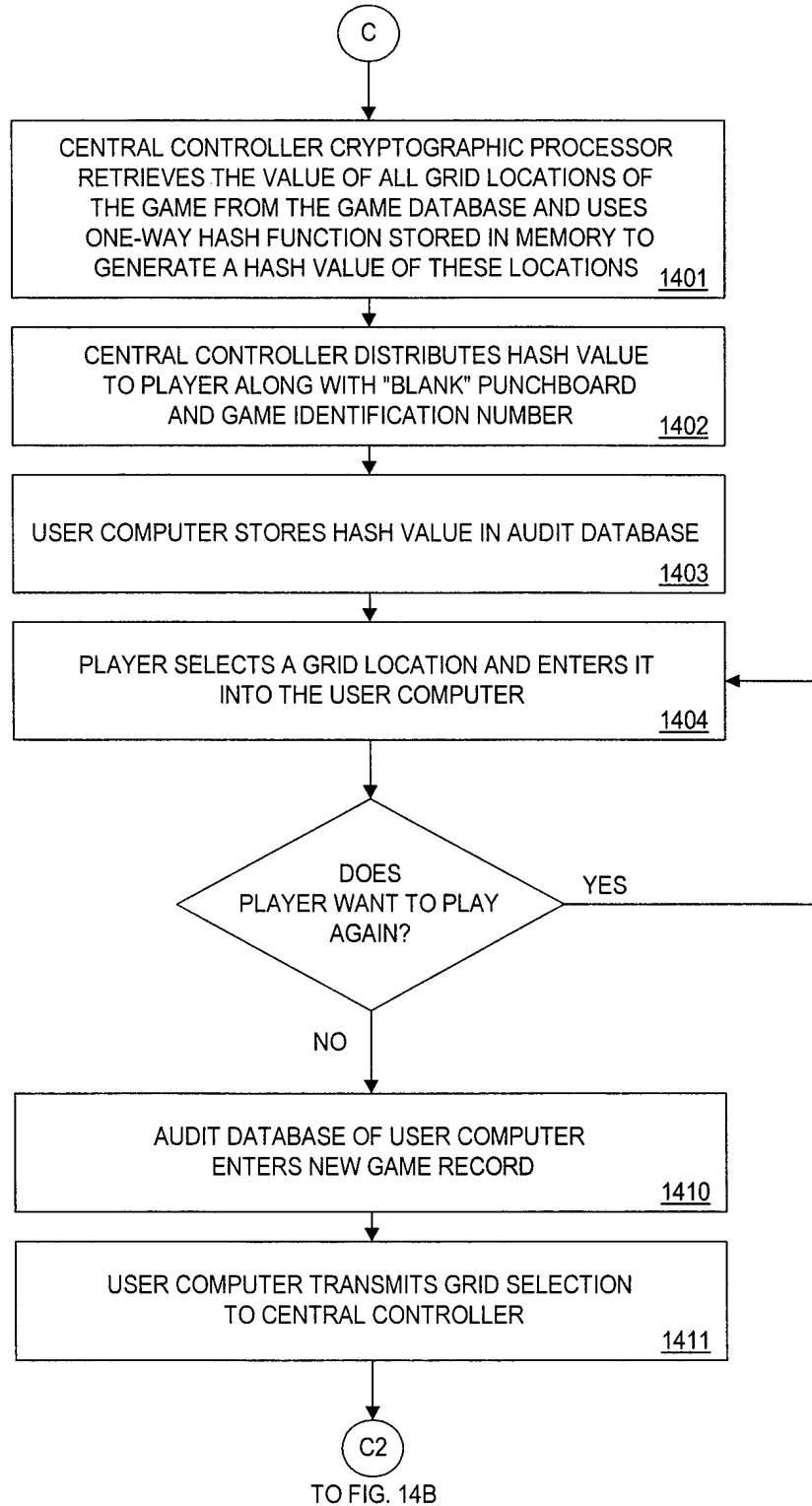
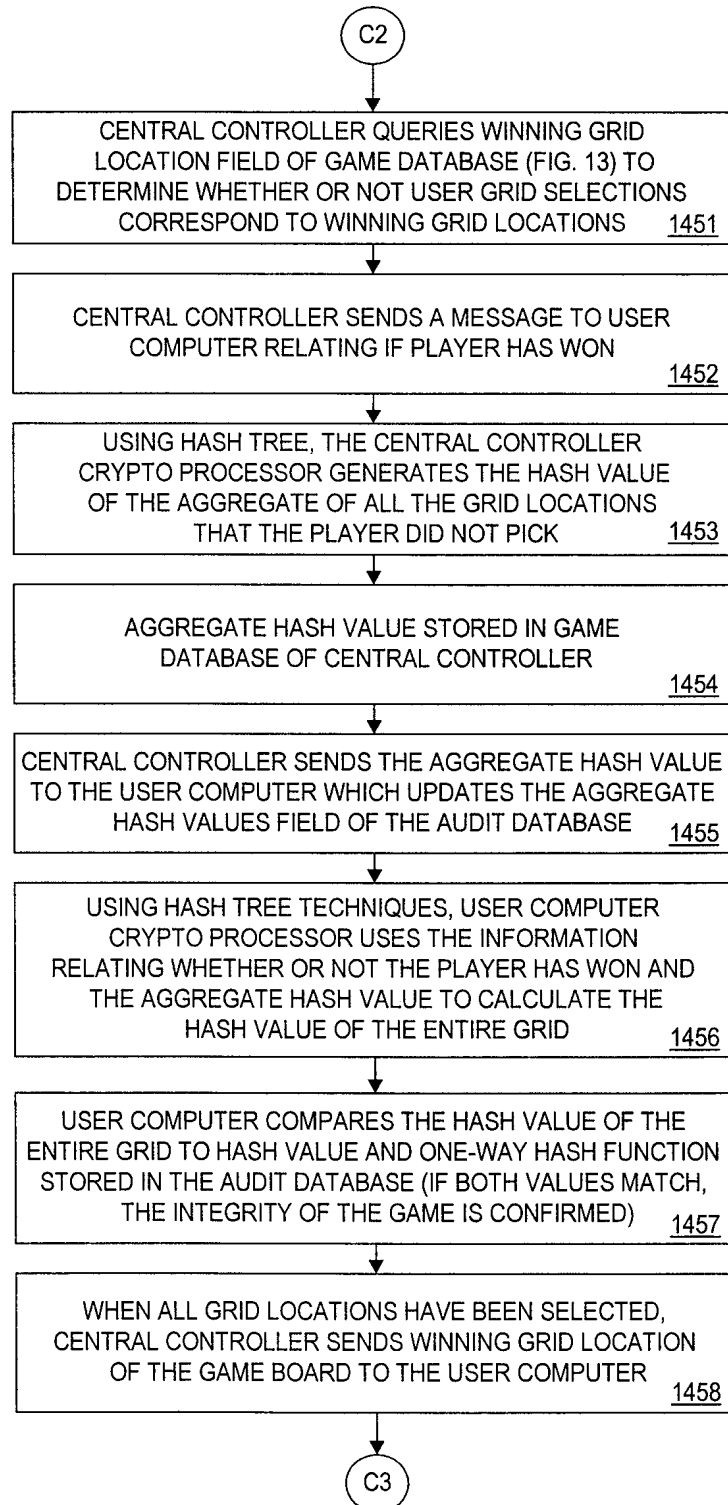


FIG. 14A

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FROM FIG. 14A



TO FIG. 14C

FIG. 14B



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FROM FIG. 14B

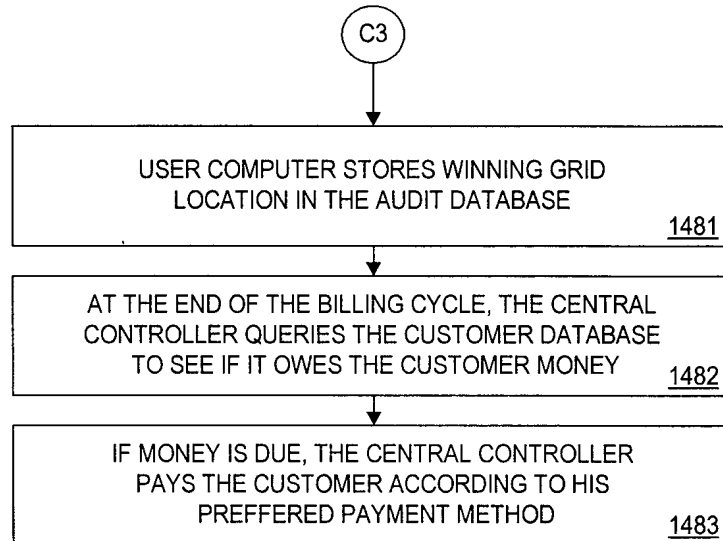


FIG. 14C

AUDIT DATABASE 311

GAME IDENTIFICATION NUMBER	SELECTED GRID LOCATION	DECRYPTED WINNING GRID LOCATIONS	ENCRYPTED WINNING GRID LOCATIONS	DENOMINATION	RANDOM KEY
901	902	1530	1520	713	1510
6465484564	J8	A4 \$5, B1 \$10, C10 \$25, E7 \$50, F2 \$50, J8 \$100, J9 \$100, K5 \$250	001011010110011	\$3.00	1100010101101 00110101011...
6564486546	A4, I2, K1	A5 \$100, D7 \$25, E8 \$50, E9 \$100, F7 \$100, G3 \$250, G6 \$500, G7 \$5	101011001100111	\$5.00	1100011001111 01011010101...
6215463168		A1 \$50, C7 \$5, B7 \$10, E9 \$50, F1 \$100, G4 \$25, G9 \$5, H1 \$25	111011001100111	\$1.00	
				\$3.00	

FIG. 15A

GAME DATABASE 212

GAME IDENTIFICATION NUMBER	CUSTOMER ID NUMBER	WINNING GRID LOCATIONS	USER SELECTED GRID LOCATION	RANDOM KEY	DENOMINATION OF GAME
901	702	903	902	1510	713
6465484564	4588	A4 \$5, B1 \$10, C10 \$25, E7 \$50, F2 \$50, J8 \$100, J9 \$100, K5 \$250	J8	110001010110 100110101011...	\$3.00
6465484565	4544	A2 \$5, B3 \$10, B4 \$100, D6 \$250, D7 \$25 E2 \$50, G1 \$50	A4, I2, K1	110001100111 101011010101...	\$5.00
	4321	A9 \$100, C5 \$50, D1 \$100, E9 \$25, F5 \$25, G4 \$50, G8 \$25, H1 \$250			
		A8 \$25, B3 \$50, C1 \$5, D2 \$10, G4 \$100, H6 \$250, J11 \$25, K3 \$100			

FIG. 15B

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FROM FIG. 8

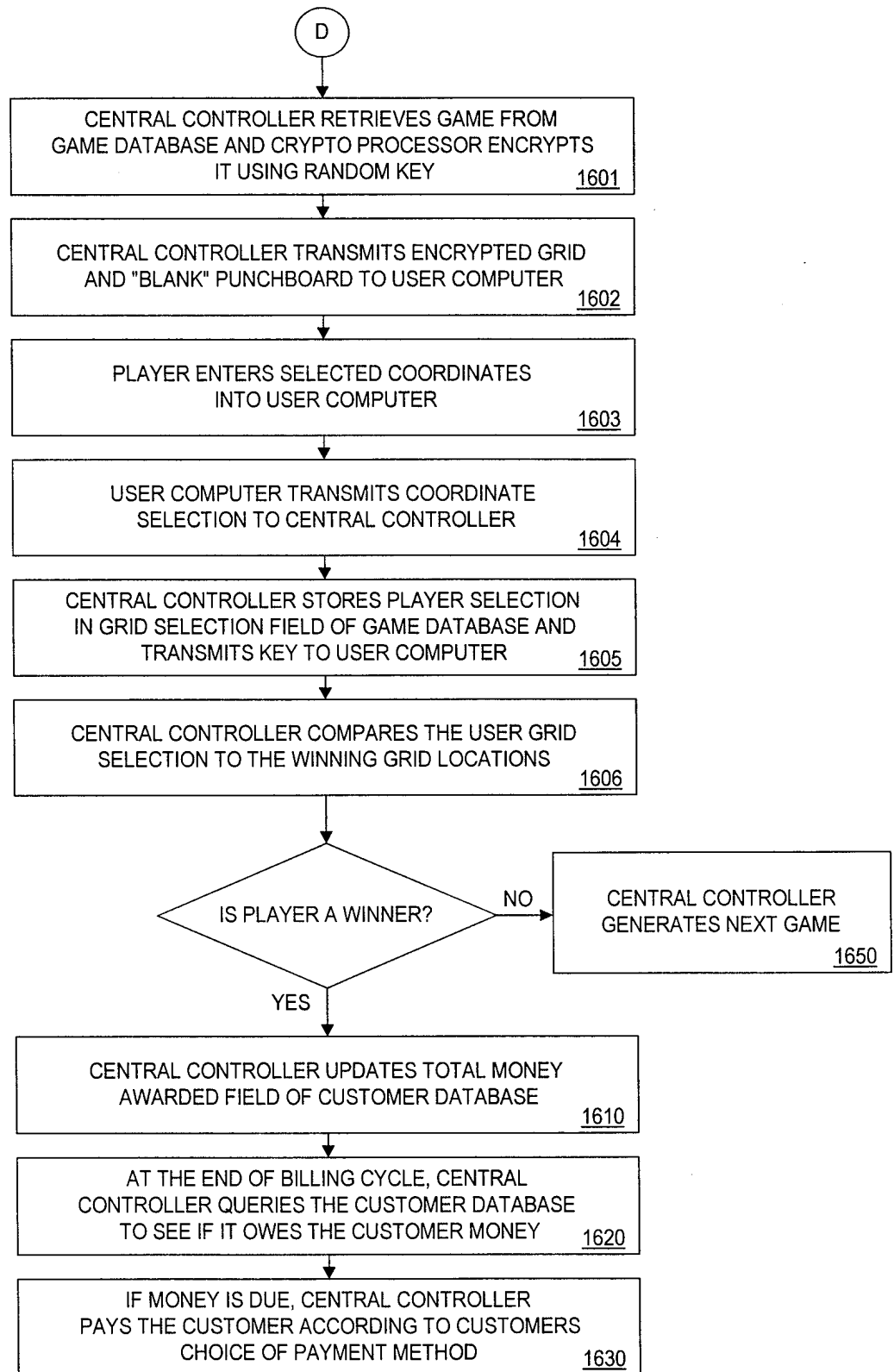


FIG. 16

AUDIT DATABASE 311

GAME IDENTIFICATION NUMBER	SELECTED GRID LOCATION	WINNING GRID LOCATIONS	DENOMINATION	CUSTOMER ID NUMBER
901	902	903	713	702
6465484564	J8	A4 \$5, B1 \$10, C10 \$25, E7 \$50, F2 \$50, J8 \$100, J9 \$100, K5 \$250	\$1.00	4588
6465484565	A4, I2, K1	A5 \$100, D7 \$25, E8 \$50, E9 \$100, F7 \$100, G3 \$250, G6 \$500, G7 \$5	\$3.00	4544
6465484566		A1 \$50, C7 \$5, B7 \$10, E9 \$50, F1 \$100, G4 \$25, G9 \$5, H1 \$25	\$5.00	4321

FIG. 17A

GAME DATABASE 212

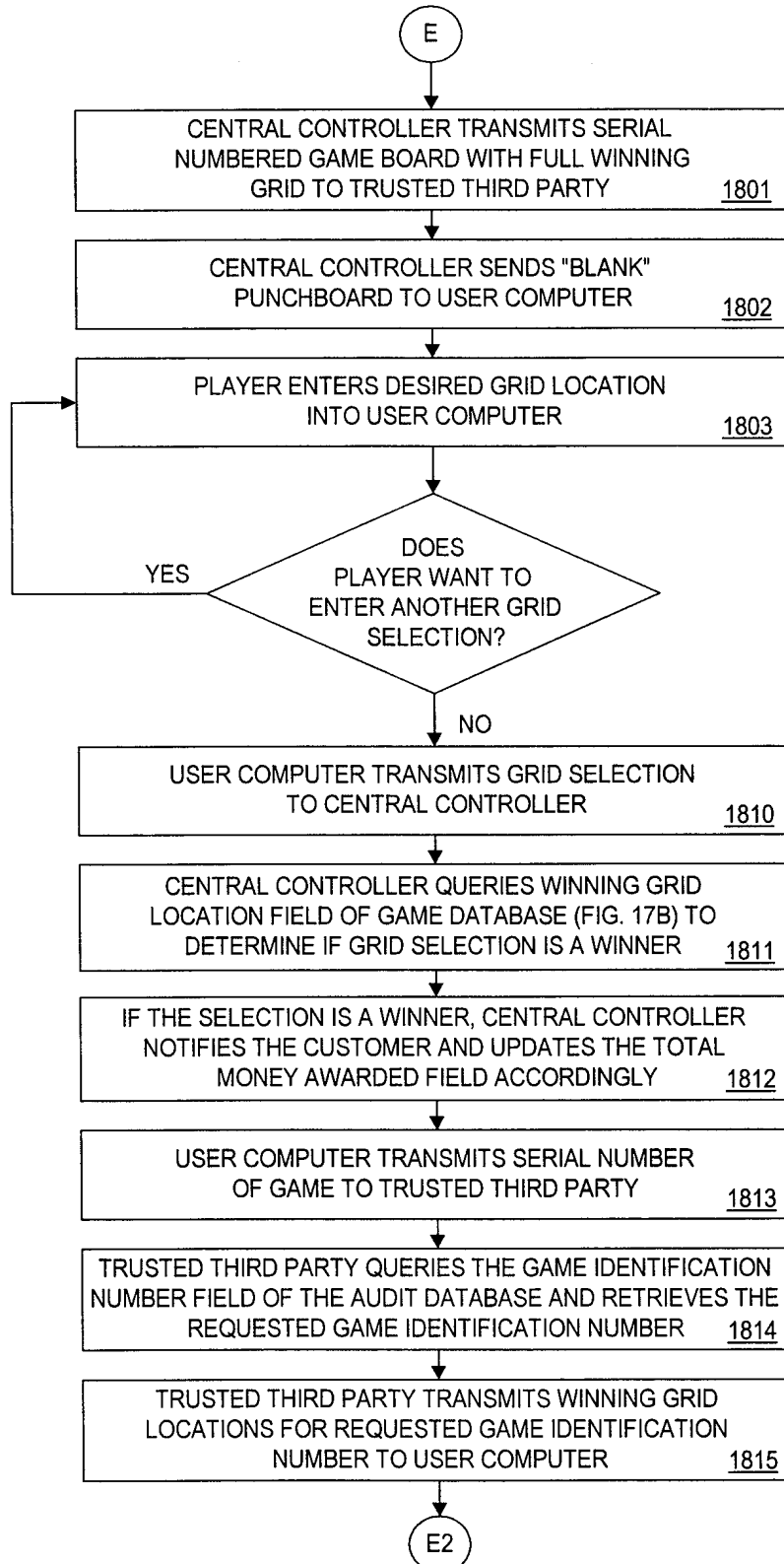


GAME IDENTIFICATION NUMBER	SELECTED GRID LOCATION	WINNING GRID LOCATIONS	DENOMINATION	CUSTOMER ID NUMBER
<u>901</u>	<u>902</u>	<u>903</u>	<u>713</u>	<u>702</u>
6465484564	J8	A4 \$5, B1 \$10, C10 \$25, E7 \$50, F2 \$50, J8 \$100, J9 \$100, K5 \$250	\$1.00	4588
6465484565	A4, I2, K1	A5 \$100, D7 \$25, E8 \$50, E9 \$100, F7 \$100, G3 \$250, G6 \$500, G7 \$5	\$3.00	4544
6465484566		A1 \$50, C7 \$5, B7 \$10, E9 \$50, F1 \$100, G4 \$25, G9 \$5, H1 \$25	\$5.00	4321

FIG. 17B

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FROM FIG. 8



TO FIG. 18B

FIG. 18A

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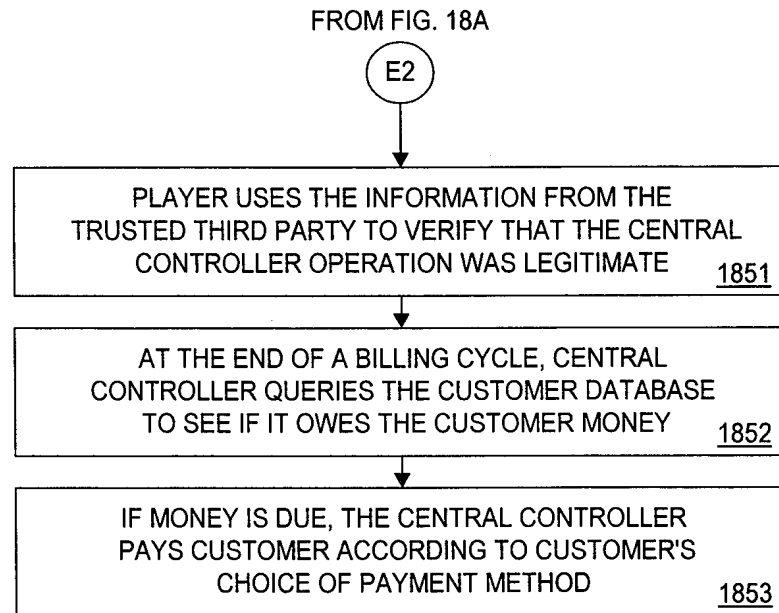


FIG. 18B